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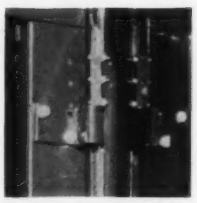
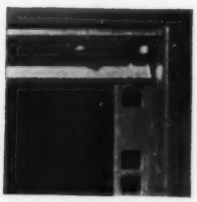
INSTRUMENT Practice AUTOMATION & ELECTRONICS

Vol. 13 No 7. Published Monthly July 1959

Great advance in rak design!



1 The strong, concealed lift-off hinges, of patented design, on the side doors



2 The quick-release mechanism allowing the rear door to be lifted easily off its hinges

3 Provision for fitting castors, obviating the need for mobile bases

4 Pre-punched holes permitting speedy, accurate baying-up

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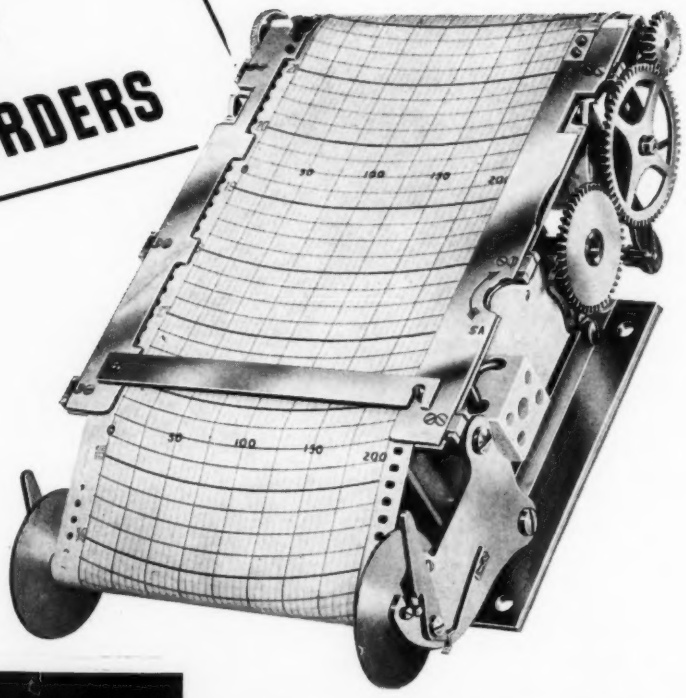

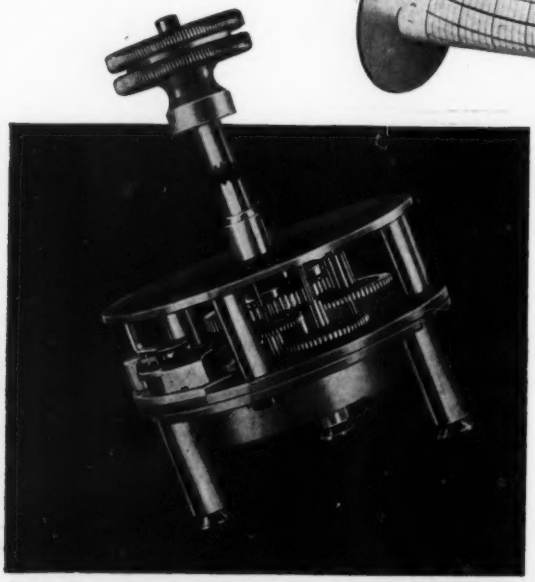

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Instruments in this range are of an advanced design incorporating many features including platform type scales. The movements are robust in construction and have a high torque/weight ratio. Low burden types are available for miniaturised control panel installations, with associated interposing voltage- and current-transformers.

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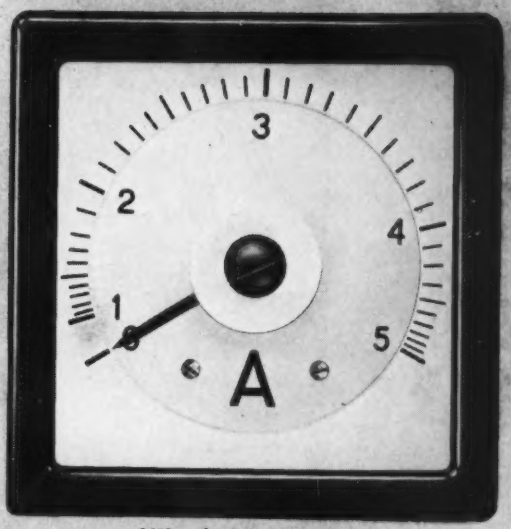
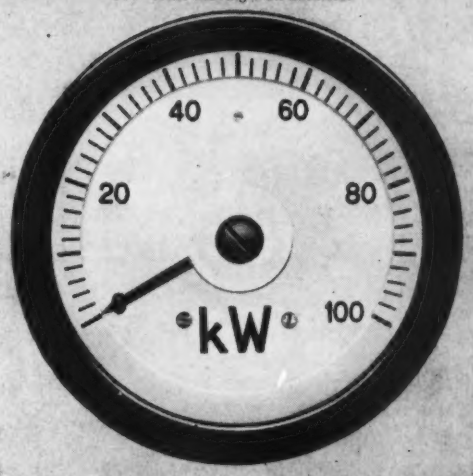


240° scale moving iron ammeter



240° scale dynamometer wattmeter

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It accepts inputs from thermocouples, pressure pick-ups, flowmeters and other transducers, displaying this information in digital form on any number of remotely situated displays. Each display has its own digital storage unit, which is capable of driving an output printer or tape punch.

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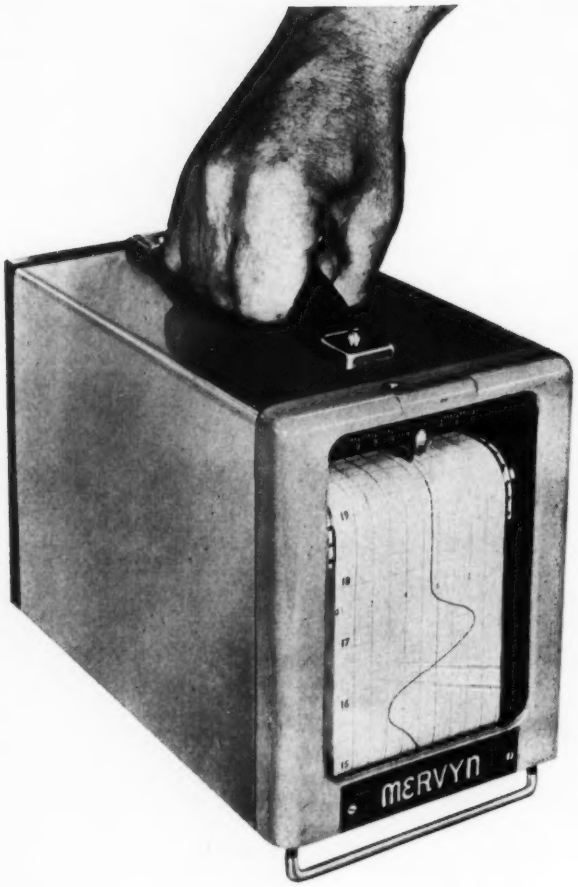

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(Patent applied for)

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to safeguard gas- or oil-fired apparatus

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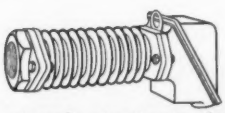
TYPES 702 & 703

*

These new high-quality ETHER controllers are designed to prevent explosions when explosive conditions exist in a combustion chamber or furnace.

*

The Type 702, for gas-fired apparatus, utilizes a flame-electrode. Flame impinges on the electrode and thus completes an electric circuit of high resistance so long as the flame exists. An electronic circuit, capable of operating an electric relay or contactor, is connected between the electrode and earth. Should flame-failure occur, a solenoid valve, operated by the relay, instantly shuts off the fuel supply to the furnace.



The Type 703, for oil-fired apparatus, utilizes a flame-eye. It is connected to an electronic circuit, similar to the one described above, and keeps the solenoid valve open for as long as the luminosity of the flame lowers the resistance of the photo-cell in the flame-eye. Should the flame fail, the fuel supply is instantly shut off and the apparatus safeguarded.

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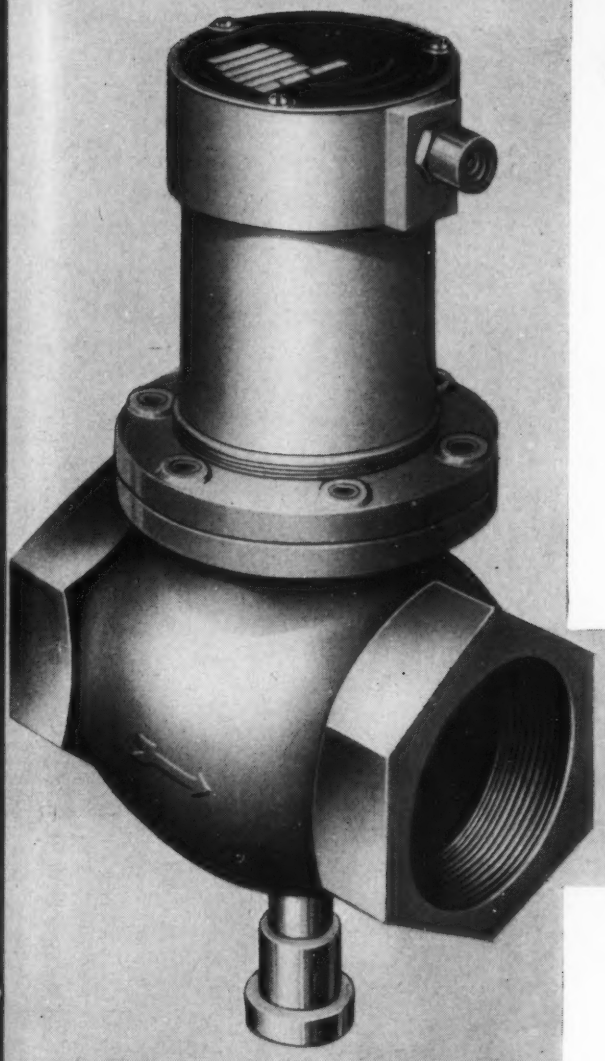

Illustrated is one of the LPGR series high-performance valves for low-pressure town gas installations

...and to complete your installation

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One of a range of highly-efficient solenoid valves, the LPGR is a safety shut-off valve for use on low-pressure town gas installations. It incorporates a hand-reset feature. When the current is switched off, the valve closes and remains closed when the current is switched on again, until it is reset by hand.

ETHER also offer a similar valve, but of the automatic-opening type, and valves for use with all types of fuel oil, bottled gases, air and many fluids.

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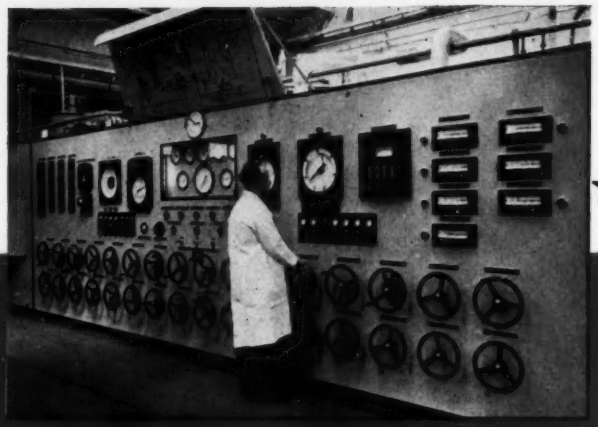
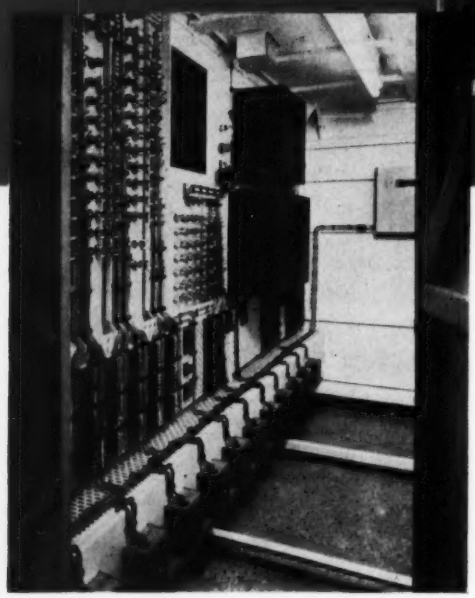


1. Control Panel manufactured for Foster Wheeler Rolls-Royce Facility Test Rig Project.

2. Final inspection before despatch from our factory at Colnbrook.



3. Panels completely piped and wired by fully trained technicians

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LIGHTER
Weighs only 10 lb.

SMALLER
12 in. wide x 9 in. high x 6 in. deep

COVERS
100 kc/s to 100 Mc/s
ON FUNDAMENTALS IN
SIX RANGES

COMPLETE
with T.P. Pad and Dummy
Aerial, etc.
**For 105-125, 210-250 v.,
40-100 c/s**

Employing standard signal generator technique, the P.1 incorporates an up-to-the-minute oscillatory circuit with special screening and filtering so that even at 100 Mc/s leakage is less than 3 microvolts.

The accurate attenuator system embodies a non-inductive slide wire followed by a five-position 75-ohm ladder network and the correctly terminated 75-ohm cable obviates mis-match reflections and provides dummy aerial output voltages substantially those indicated by the attenuators.

Special Models available: P1/M for 105-125 volts, 210-250 volts, 40-100 c/s. P1/NA for 117 volts, 25-60 c/s.

Full technical details in Leaflet C47

TYPE P1
NETT PRICE IN U.K.
£25

GD74

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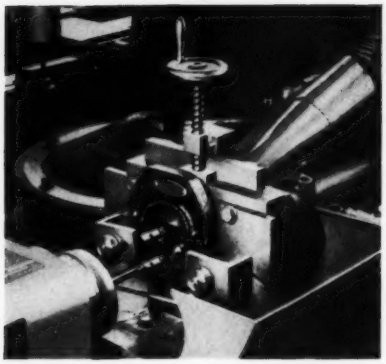
Circle 11 for further information

The Caliper is normally supplied as a 'GO' and 'NOT GO' combination gauge so that both tests can be applied in one action, but is also available as 'GO' only or 'NOT GO' only.



A precision co-ordinate frame boring machine for ensuring parallelism and centre distance of anvil mountings.

Adjusting screws, protected by cover plates, allow for a wide range of work diameters and tolerances. The gauge, after long usage, can also be re-adjusted many times to size so that the necessity for regrinding is eliminated.

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The Horstmann Model 52 Screw Caliper Gauge puts accuracy in your hands. In addition to the features displayed above, it incorporates many other advantages, all of which contribute to fine accuracy, versatility, long life and ease of handling. The anvils are set so that they do not roll—all shearing action is eliminated—the caliper is suitable for either left- or right-hand threads—and it is ideal for gauging Acme forms and shouldered work. Model 52 is available in a full range of B.A., American, Unified, Whitworth and Metric forms of thread.

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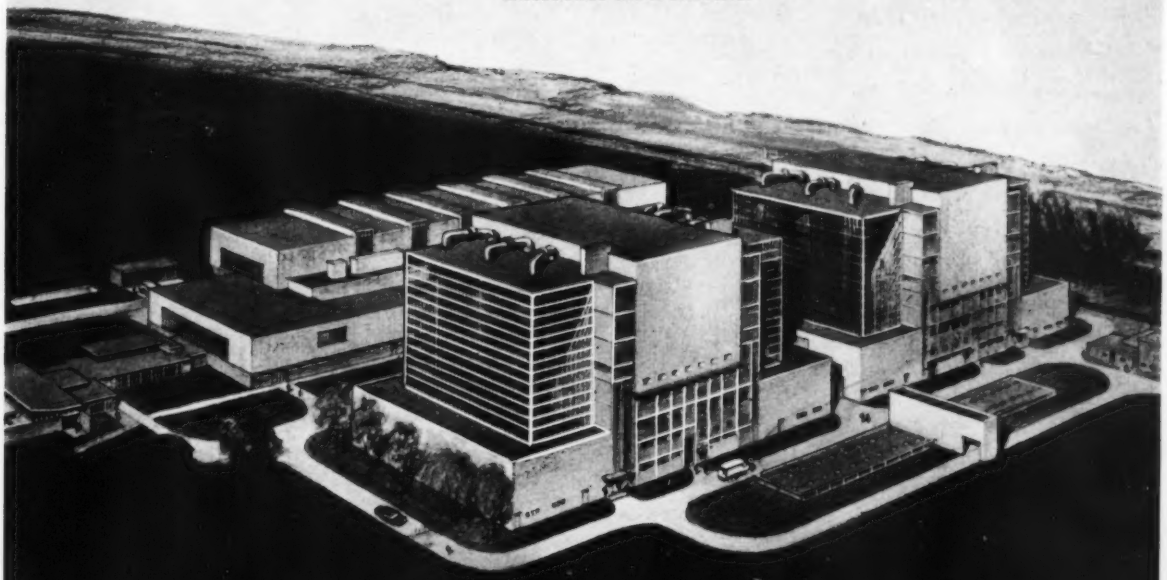

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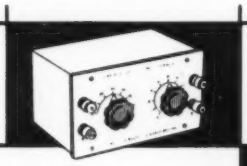
TYPE A64 (Resistive)
Attenuation Range: 0-70 dB in 1 dB steps
Input and Output Impedance: 600 ohms. **£15.** — SEND FOR LEAFLET **35**



V. H. F.

TYPE A37
As Type A38 but supplied less resistors for customers to fit their own ladder network **£3.15** — **39**

TYPE A38 (Resistive)
Maximum Attenuation: 80 dB.
Impedance: 75 ohms. **£4.7.6**

TYPE A55 (Inductive)
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Attenuation Range: 99 dB in 1 dB steps
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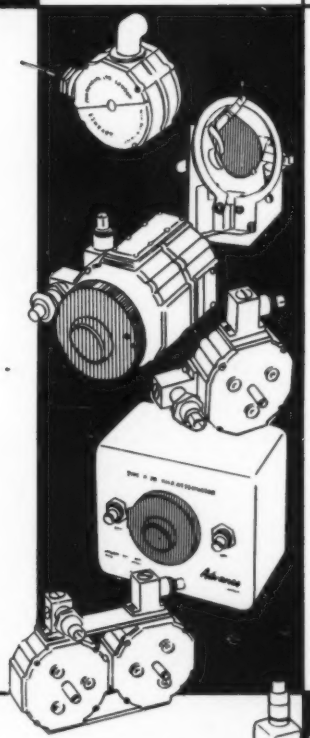
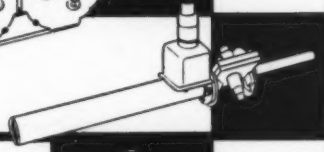


U. H. F.

TYPE A57 (Inductive)
Attenuation Range: 126 dB
Output Impedance: 75 ohms. **£60** — **39**



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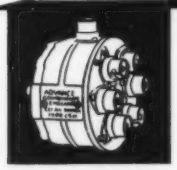
Small dimensioned switches, for use up to V. H. F., employing the same clean break mechanism as used in Types A37 and A38 (6 position) and A76 and A94 (10 position) Attenuators. — **39**



MODEL CS 10	MODEL CS 11	MODEL CS 12
10 position	6 position	6 position (terminated)
£8.10.0	**£5.0.0**	**£5.10.0**

GD78

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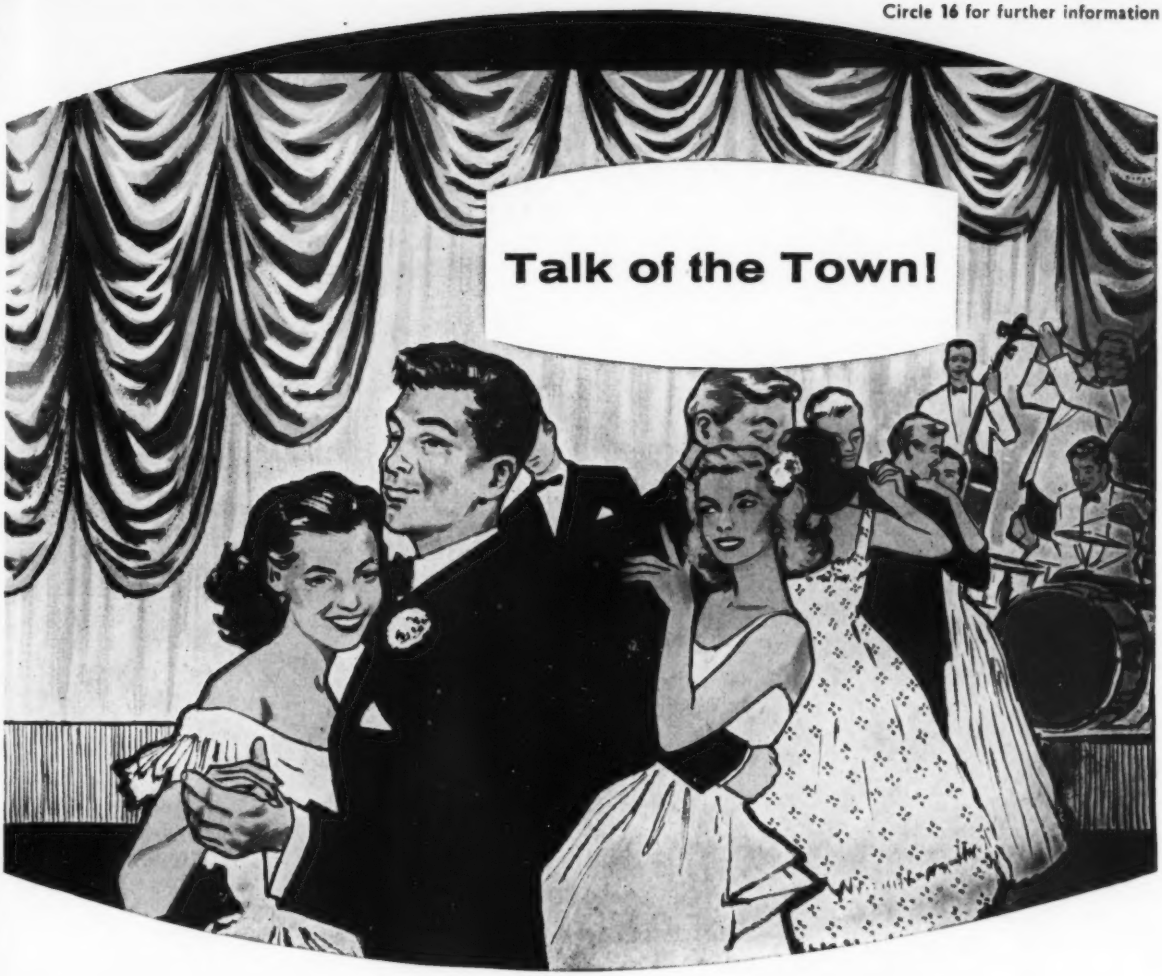

Patrons who visit 'The Talk of the Town' are fascinated by two novelties of modern theatre technique: the orchestra with its 'band waggons' moving to and fro, rising to the stage and descending below eye level, and the endless variety of curtain movements.
British Klockner Switchgear Ltd., manufacturers of all types of control gear for theatrical equipment, designed the apparatus that works these wonders from a simple push-button panel.
These apparent miracles rely on multiple Bridge Circuits and intrinsically safe track circuiting; for this system British Klockner Switchgear Ltd. rightly decided that they must use TMC Carpenter Polarized Relays. For they know, as do the knowledgeable in almost every industry, that the efficiency and reliability of TMC products are, indeed, 'the talk of the town'.

Photograph by courtesy of 'The Talk of the Town' (previously known as The London Hippodrome.)

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---with the 'feather touch' control

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- SAVES FATIGUE IN PACKING
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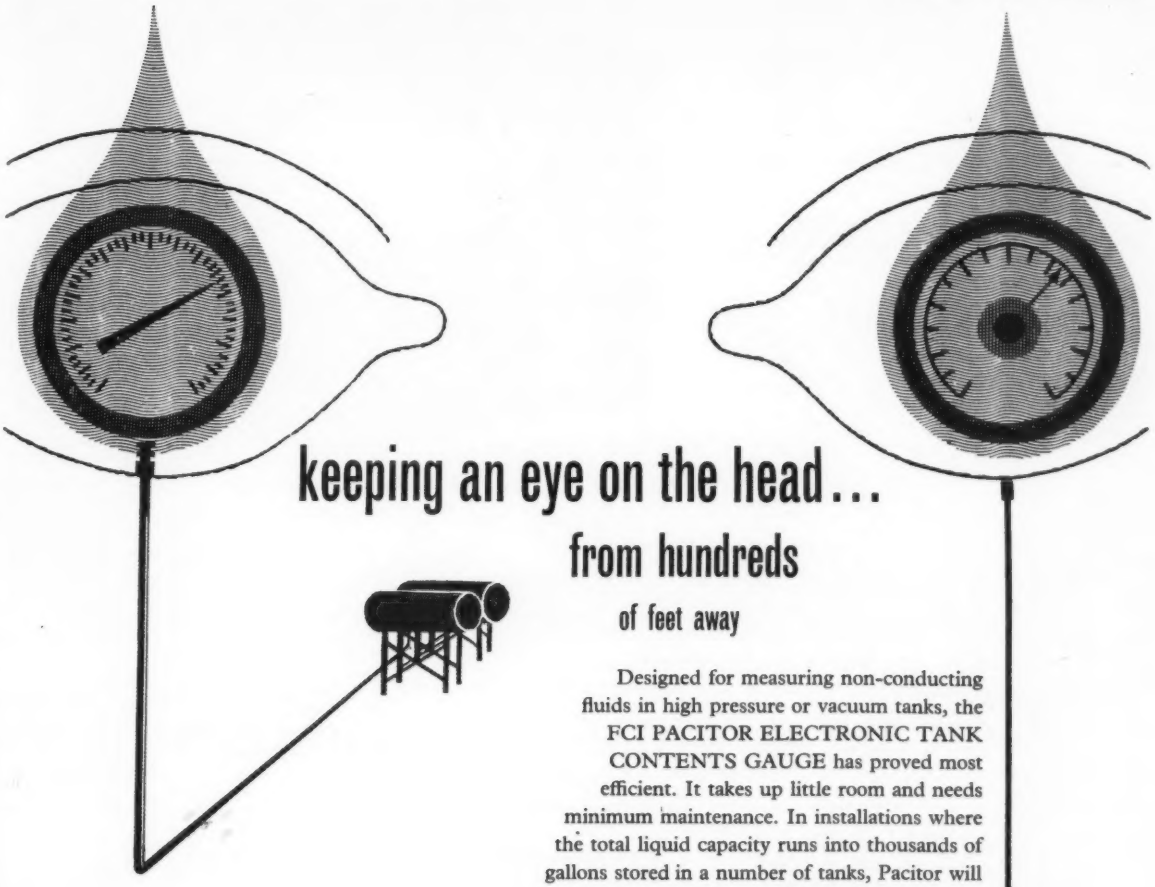

keeping an eye on the head...

from hundreds

of feet away

Designed for measuring non-conducting fluids in high pressure or vacuum tanks, the FCI PACITOR ELECTRONIC TANK CONTENTS GAUGE has proved most efficient. It takes up little room and needs minimum maintenance. In installations where the total liquid capacity runs into thousands of gallons stored in a number of tanks, Pacitor will give an accurate indication of the summated or individual tank contents. The Gauge has been certified safe for gases in Groups II and III.

The FCI HYDROSTATIC TANK CONTENTS GAUGE measures the head of liquid in almost any type of non-pressurised tank, wherever it's situated and regardless of size and height. The gauge is of the remote-reading type and there is a wide choice of different kinds of installation to suit individual needs. It is suitable for measuring corrosive and non-corrosive liquids; liquids containing solid matter in suspension such as paper pulp; viscous fluids such as syrups.

Full technical details from:

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THE PHILIPS GM.6012 BROADBAND MILLIVOLTMETER

Eminently suitable for measurements in the acoustical and ultrasonic fields, electrical measurements of mechanical vibrations, measurements on I.F. and A.F. amplifiers and measurements on carrier telephone installations.

Technical data

Measuring ranges: 1 mV — 300V f.s.d. dB scale from — 80 dB . . . 52 dB O dB = 1 mW in 600 Ω (0.775 V).

Frequency range: 2 c/s...1 Mc/s

Overall accuracy: 20 c/s...100 kc/s ± 2.5%. 2 c/s...1 Mc/s better than ± 5%.

Input impedance: 1 mV...3 V range 4 M Ω parallel with 20 pF. 10 V...300 V range 10 M Ω parallel with 10 pF.

Mains supply: 110-245 V. 40-100 c/s.

Sole Distributors in U.K.:

Product of N. V. Philips, Eindhoven.

RESEARCH AND CONTROL INSTRUMENTS LIMITED

INSTRUMENT HOUSE, 207 KING'S CROSS ROAD, W.C.1. TELEPHONE: TERMINUS 8444

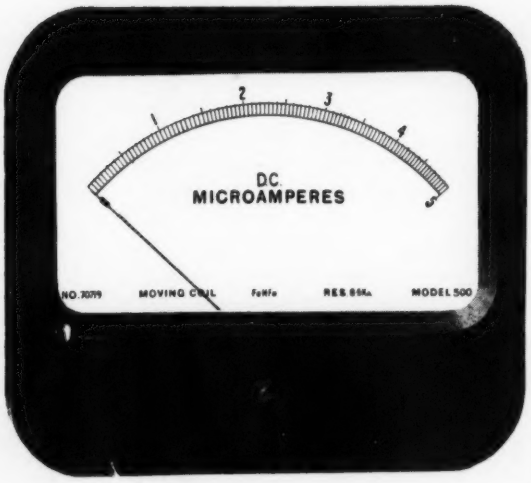
(RCI.0414)

WHY Taylor Panel Meters?

BECAUSE OF THESE OUTSTANDING FEATURES—

- ★ **Centre Pole Movements with high torque to weight ratio.**
- ★ **Very high sensitivity (commencing from 5 micro-amps).**
- ★ **Inherent magnetic shielding.**
- ★ **Extreme robustness and rigidity.**
- ★ **Stick free operation.**
- ★ **Permanent method of dry balancing.**
- ★ **Exceptional coil clearance—trouble-free gap.**
- ★ **Proven reliability.**
- ★ **Competitive prices : Prompt delivery for prototypes.**

Taylor Centre Pole Meters can be supplied with scale lengths from 2 in. — 5 in. in round and rectangular cases.



Taylor

Write for full details and free catalogue to

TAYLOR ELECTRICAL INSTRUMENTS LTD. (Dept. I.P.)

MONTROSE AVENUE, SLOUGH, BUCKS. *Telephone: SLOugh 21381*

Circle 21 for further information

PLATINAX II

(*Registered Trade Mark*)

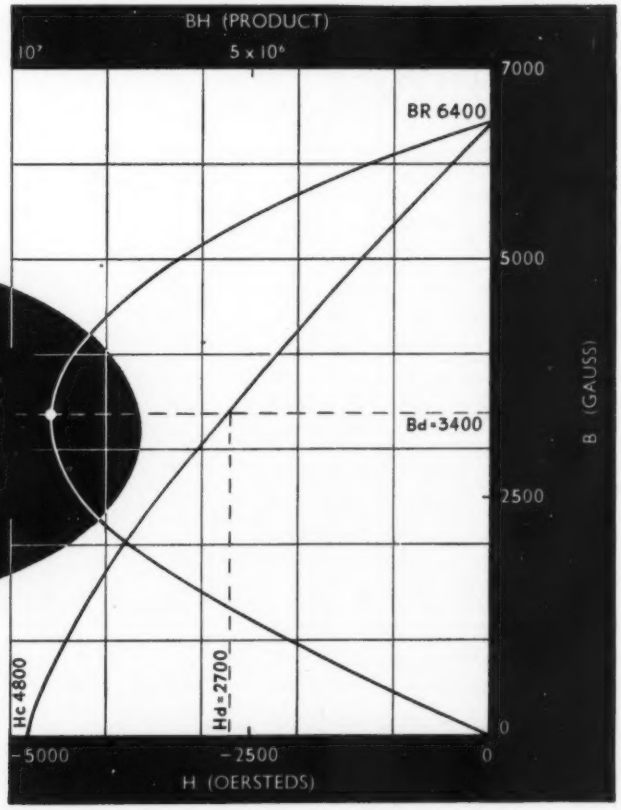
Cobalt-platinum Magnetic Alloy

Platinax II is one of the most powerful permanent magnet materials known.

Before a special heat treatment that develops its outstanding magnetic properties, Platinax II can be machined, rolled and drawn without undue difficulty, and it therefore lends itself to the manufacture of magnets of complex shapes or small sizes that would be impracticable in other materials.

Platinax II is available in the form of finished unmagnetised parts, or as rod, wire and strip. Small components can be supplied fully magnetised.

Typical Demagnetisation and Energy Product Curve



BH Max
$9{\cdot}2 \times 10^6$

One of the Specialised Products of

Johnson Matthey

JOHNSON, MATTHEY & CO., LIMITED, 73-83 HATTON GARDEN, LONDON, E.C.1
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180

Circle 22 for further information

Portable . . .

TYPE MC—1 (MK.III)

CONDUCTIVITY MEASURING BRIDGE

The type MC—1 portable electrolytic conductivity measuring bridge is a truly portable instrument designed to give long and trouble free service in the laboratory or in the field.

The instrument, which is now used by the Electricity Generating Stations and the principal Water Purification Engineers throughout the country, is supplied complete with an ELECTRONIC SWITCHGEAR patented, non-glass, conductivity measuring cell and all accessories, in a convenient hardwood carrying case. The development of low power consumption transistorized circuits, which operate from a small long life dry battery, has resulted in the production of a particularly compact and light-weight precision instrument.

The range of measurement is from $0{\cdot}1—10^6$ micromhos/cm^3.

Price
£66

DESCRIPTIVE LEAFLET MC AVAILABLE ON REQUEST

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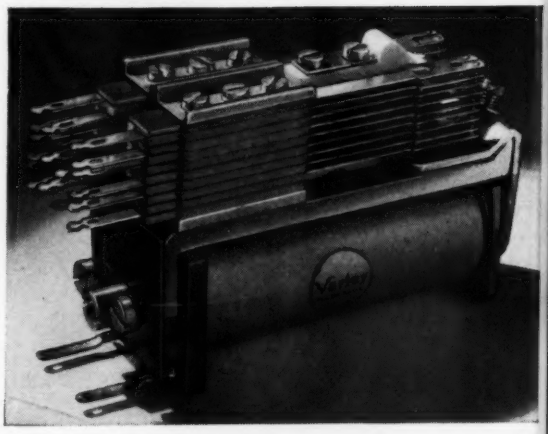
WORKS ROAD · LETCHWORTH · HERTS
Telephone: Letchworth 1835
London Office: **47 Victoria Street, Westminster, S.W.1**
Telephone: ABBey 2771/5

Circle 23 for further information

A name that means something!



Varley
REGD. TRADE MARK

P.O.3000 RELAY

. . . a name that means quality All VARLEY relays are built and adjusted to Post Office specification using new piece parts throughout.

COILS All values from .1 to 100 K.ohms can be supplied, also double and sandwich windings.

CONTACTS

TYPE	RATING	MAXIMUM NUMBER
Light Duty Twin Silver.	150V. 0.3 amps	8 M or B 8 C or K
Light/Heavy Duty Silver.	150V. 2.5 amps	8 M or B 4 C.
Light/Heavy Duty Silver.	250V. 2.5 amps	4 M or B 2 C.
Heavy Duty Elkonite.	150V. 5 amps	8 M or B 4 C.
Heavy Duty Elkonite.	250V. 5 amps	4 M or B 4 C.

A name that means promptness. Prototype samples can be supplied within 7 days—full production in 2-3 weeks.

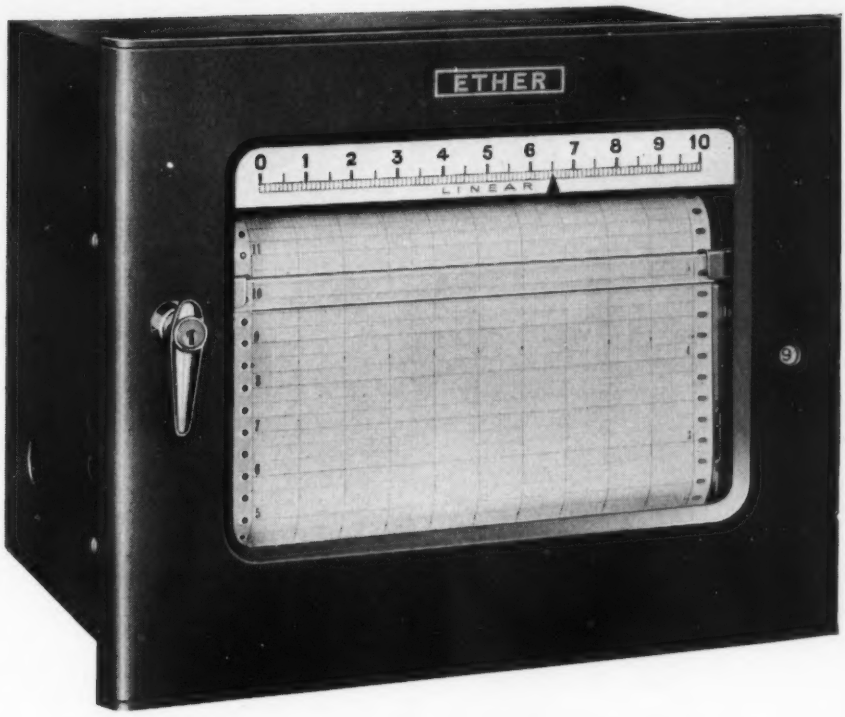
For further details write to Dept. R.3

OLIVER PELL CONTROL LIMITED
Cambridge Row, Burrage Road, Woolwich SE18
Telephone: WOOlwich 1422 Telegrams: Olipel, London, SE18
TA2547

Circle 24 for further information

NEW

high standards of performance at infinitely lower cost!



SERIES 1500

POTENTIOMETER
RECORDERS & CONTROLLERS

* *No standardising required* * *Easy range changes*
* *11-in. calibrated chart with seven speeds*
* *Full-scale balancing pen carriage*
(with speeds of 2, 5 or 13 seconds)
* *Models available to record from one to eighteen independent points*

These new ETHER instruments combine a remarkably high standard of performance with simplicity in operation, and require a minimum amount of maintenance. Models are available which measure, indicate, control and give a permanent record of temperature, using thermo-couples, resistance-bulbs or radiation-tubes. Speed, strain and any other variable that can be resolved into an electrical signal can also be recorded. Write now for comprehensive technical data!

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Representatives throughout the U.K.
Agents in all principal countries

ETHER LIMITED

TEMPERATURE & PROCESS CONTROL EQUIPMENT FOR ALL INDUSTRIES

Circle 25 for further information

GORDON

MONO GAS ANALYSIS RECORDERS

Something New!

Whilst remaining basically as it has been well known for many years, recent modifications to the Mono Recorder improve its

ACCURACY, RELIABILITY and APPEARANCE

The Range of MONO RECORDERS available has also been extended and includes:—

SIMPLEX MONO for combustion control and for recording accurately CO_2 in any gas mixture.

DUPLEX MONO showing CO_2 and $CO+H_2$ for combustion control.

E-K DUPLEX MONO showing CO_2 and $CO+H_2$ for furnace atmosphere control, etc.

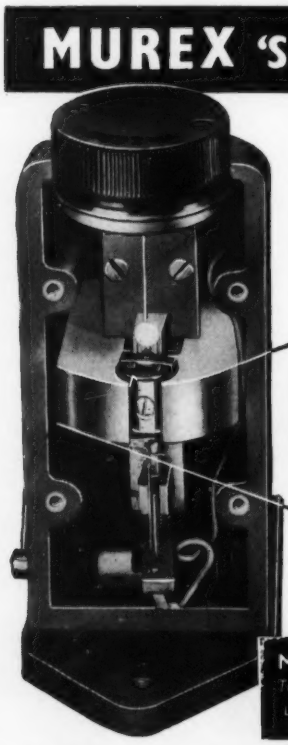
OXYGEN MONO for combustion control and other purpose where accurate O_2 readings are necessary.

TRIPLEX MONO showing CO_2, $CO+H_2$ and H_2 alone, on one chart, for producer gas, blast furnace gas, synthesis gas, etc

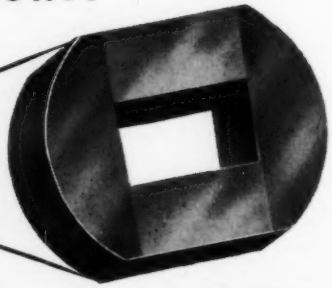
JAMES GORDON & CO. LTD. · DALSTON GARDENS · STANMORE · MIDDX

A member of the Elliott-Automation Group.

MUREX 'SINCOMAX' MAGNETS



are used in this **E.E.L. GALVANOMETER UNIT**



Actual size of magnet

In this new E.E.L. Galvanometer made by Evans Electroselenium Ltd. Murex 'Sincomax' magnets are used to meet the need for low leakage, high flux density and magnetic stability.

Photographs of complete unit and Galvanometer Suspension by courtesy of Evans Electroselenium Ltd.

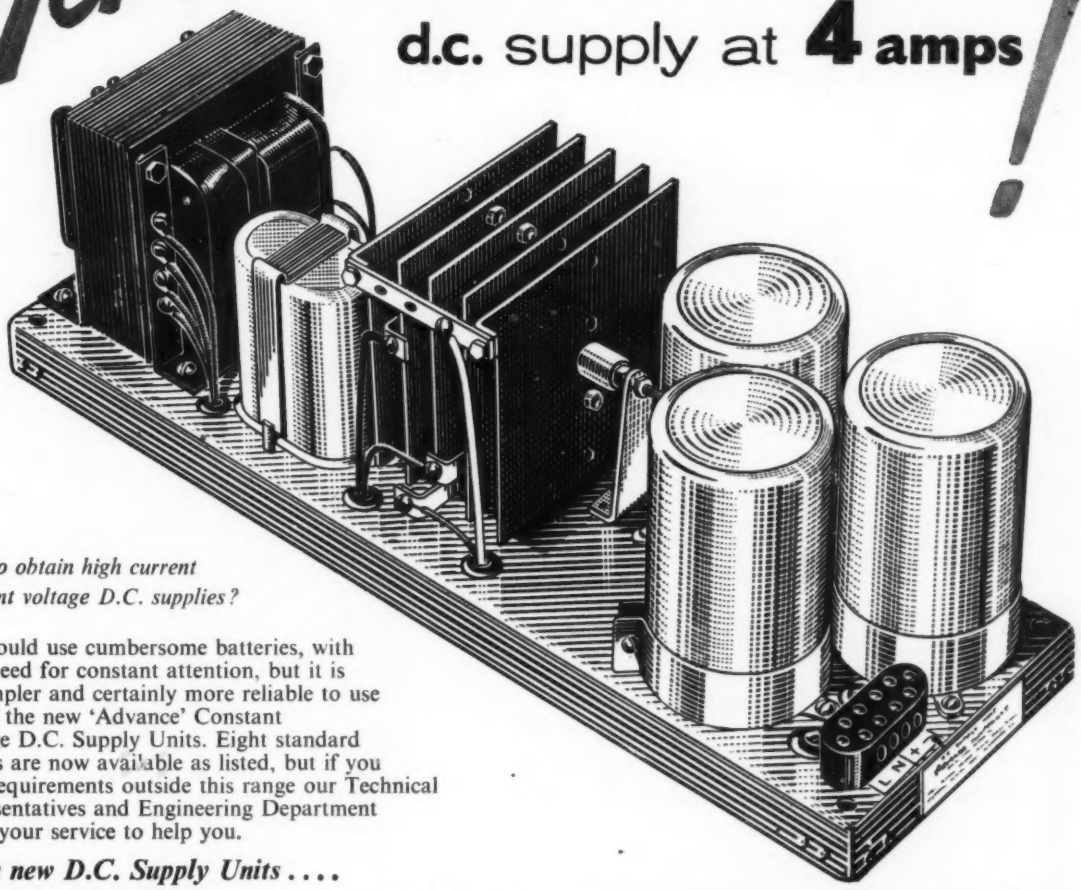
MUREX LTD. (Powder Metallurgy Division) RAINHAM · ESSEX

Telephone: Rainham, Essex 3322 Telex 28632 Telegrams: Murex, Rainham, Dagenham Telex

LONDON SALES OFFICE CENTRAL HOUSE, UPPER WOBURN PLACE W.C.1

Circle 26 for further information

Here is a 12v. stabilized d.c. supply at 4 amps!



How to obtain high current constant voltage D.C. supplies?

You could use cumbersome batteries, with their need for constant attention, but it is far simpler and certainly more reliable to use one of the new 'Advance' Constant Voltage D.C. Supply Units. Eight standard models are now available as listed, but if you have requirements outside this range our Technical Representatives and Engineering Department are at your service to help you.

These new D.C. Supply Units ....

- Provide **HIGH CURRENT OUTPUT AT LOW COST**
- Are **SMALL IN SIZE AND WEIGHT FOR VA OUTPUT**
- Have **HIGH ENERGY RESERVOIR**, thus are suitable for pulse, intermittent or variable loads
- Operate with **HIGH EFFICIENCY**

TYPE	OUTPUT RATINGS		PRICE
DC.1	6 volts	1.25 amp	£15
DC.2	6 volts	4.00 amps	£25
DC.3	12 volts	1.25 amp	£18
DC.4	12 volts	4.00 amps	£27
DC.5	24 volts	1.00 amp	£20
DC.6	24 volts	5.00 amps	£30
DC.7	48 volts	1.00 amp	£25
DC.8	48 volts	4.00 amps	£35

Advance CONSTANT VOLTAGE

D.C. POWER SUPPLIES

Full technical details available in Leaflet C59

Advance COMPONENTS LIMITED *Mains Stabilization Division*

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Circle 28 for further information

You should learn more about the

Coley

PYROMETER CONTROLLER

Embodying an extremely simple circuit without the use of any electronic components, transistors, lenses or reflectors, the Coley Z5 will control with an accuracy of ·25% at any temperature up to 1600°C.

Leaflet Z5 will tell you all about it.

COLEY THERMOMETERS LIMITED
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Phone: Isleworth 4232 *Grams: BRYCO BRENTFORD*

Circle 29 for further information

THE BRYANS

P.V. SYSTEM TEST SET

CATALOGUE No. 1858

A portable self-contained test set for pressure and vacuum installations and associated gauges. Range 0-100 P.S.I. and 0-30 inches H.G. negative pressure.

For further details write to:-

BRYANS AEROQUIPMENT LIMITED

Specialists in precision measurement of pressure, temperature and speed. Design and production facilities available for test equipment and multiple panel building including electrical and electronic work.

WILLOW LANE MITCHAM JUNCTION SURREY
TELEPHONE: MITCHAM 5134 (5 LINES)

Finding relays a puzzle?

We're old hands at straightening out relay problems.

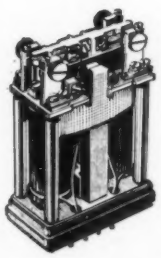
After all, we've been designing and making them for years (over 50 in fact)—big ones, little ones, sensitive ones, general purpose ones; open, dust protected and hermetically sealed, high current, low capacitance, high 'g'—in fact the lot.

We admit that we can't always come up with the answer off the shelf—who can with daily developments in electronics, radar, airborne equipment, nucleonics, reactor instrumentation, etc.? But all of these industries are continually finding Ericsson relays the perfect answer to their problems.

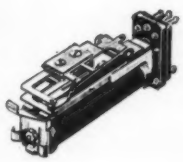
If you are stuck with a very special project and are behind schedule, let us lend you an expert hand.

Help us to help *you*—give us as much information as possible, for an early solution.

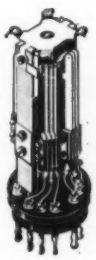
Here are a few of our current miniatures



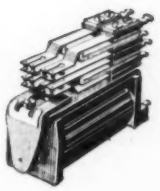
POLARIZED RELAY
Versatile, sensitive and stable. Available with one or two change-over contacts. Dust cover or hermetically sealed. Long or short frame models.



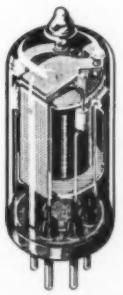
TYPE 1A RELAY
Highly sensitive—non-polarized type with balanced moving system for high 'g' performance. Hermetically sealed. With one change-over.



TYPE 2 RELAY
General purpose type with balanced moving system. Normal and heavy duty contacts up to 4 change-overs. Hermetically sealed.



G.P. RELAY
For general purpose applications. Multi-contacts up to 4 units. Open, dust cover or hermetically sealed with normal, heavy duty or low capacitance contacts.



MGL RELAY
Specially designed for electronic and nucleonic applications. One change-over contact. Fits B7G base. Also available with metal can.

Full details of these and other relays can be obtained from:

ELECTRO-MECHANICAL DIVISION
BEESTON · NOTTINGHAM · ENGLAND

ERICSSON

Ericsson Telephones Limited
Head Office: 22 Lincoln's Inn Fields
London, W.C.2. Tel. HOLborn 6936

E107-65

Circle 31 for further information

The PERTH-O-METER

is the most comprehensive SURFACE ROUGHNESS Measuring Instrument made up to now. It measures not only C.L.A. but provides the right answer to every surface roughness problem by measuring also maximal depth, P.V.A., percentage bearing area, depth of smoothness, etc.

Magnification up to 100,000 and graph recorder with up to 16 various speeds.

The new Workshop models with portable measuring head are now available in this country with short delivery. Tracer systems for all special purposes, including radius attachments, etc.

The Perth-o-Meter is a true length measuring instrument and not a comparator crystal instrument.

Sole Agents for Great Britain:

RUBERT & CO. LTD.

ACRU WORKS, DEMMINGS ROAD, CHEADLE, CHESHIRE. Telephone: Gatley 5855

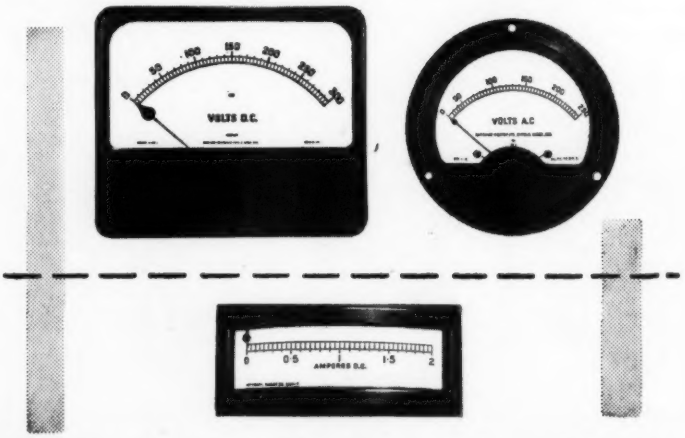
WESTON

PANEL INSTRUMENTS

Complete flexibility in panel design is made possible by the Weston range of "miniatures" which includes round, rectangular and edgewise models. Round models are housed in cases of 2″, 2½″ and 3½″ diameter . . . or, to harmonise with rectangular panels, the rectangular type is available, giving an increase in scale length of approximately 50% over the equivalent round models. Horizontal edgewise instruments are available with scale lengths of 2½″ and 3½″.

Moving iron, moving coil, a.c. rectifier and h.f. thermocouple models are offered—all with the accepted Weston qualities of accuracy and reliability.

Full particulars are to be found in leaflets—Lists Nos. W1, W2, W3 and W4, copies of which are available on request.



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SANGAMO WESTON LTD · ENFIELD · MIDDLESEX

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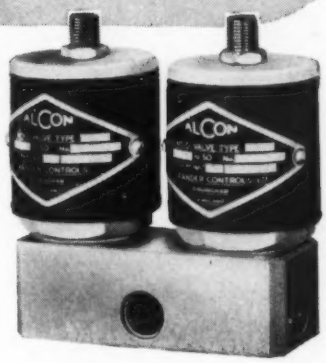
ALCON

A TIME-TESTED success series!



3-WAY & 4-WAY SOLENOID OPERATED VALVES ..... DESIGNED FOR USE WITH AIR CYLINDERS

•

MIDGET 3-WAY SOLENOID VALVE, TYPE AC30 (*Top left*)

For use on air up to 150 p.s.i. and port sizes to $\frac{1}{8}$" diameter screwed $\frac{1}{4}$" B.S.P. used for controlling air operated cylinder and diaphragms with spring return.

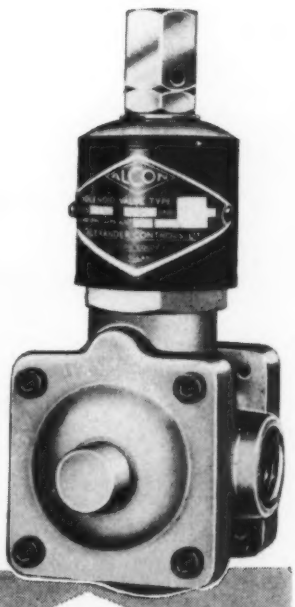
MIDGET 4-WAY SOLENOID VALVE, TYPE AC40 (*Top right*)

For use on air up to 150 p.s.i. Port sizes up to $\frac{1}{8}$" screwed $\frac{1}{4}$" B.S.P. used to control double acting air operated cylinders and diaphragms.

3 & 4 WAY SOLENOID OPERATED VALVES, TYPES SPC.3 & SPC.4

For use on air up to 150 p.s.i. with full $\frac{1}{4}$" bore screwed $\frac{1}{4}$" B.S.P.—give rapid action of largest cylinders and diaphragms.

These valves have an electrical consumption of only 10 watts, they are capable of acting at speeds up to 300 cycles a minute, Moving parts have low inertia giving millions of trouble-free operations.



Write for illustrated literature.

ALEXANDER CONTROLS LTD.,
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Telephone : SUTton Coldfield 5227-8-9

MEMBER OF THE CONCENTRIC GROUP OF COMPANIES

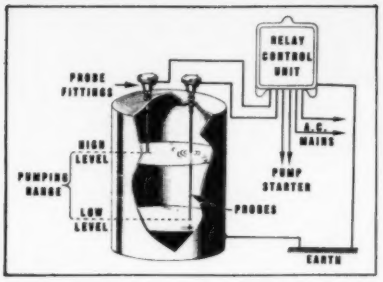
... FOR USE WITH
Air-operated Diaphragm & Cylinder-operated Valves

ALCON

Circle 34 for further information

level controls

high/low pump switching or level signalling at low cost



a typical level control application

THE well tried Elcontrol system uses a single relay unit and two sturdy probes, installation is easy and there is nothing to go wrong.

Conductivity type for all liquids except insulants.

Widely used for foam level control, oil/water interface detection; works very well on condensate. Probe system operates at very low voltage. Flame-proof and intrinsically safe versions can now be supplied.

Appointed Agents	*Telephone*
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N. WEST: A. M. Lock & Co. Ltd., Union St., Oldham.	*Main 6744*
SCOTLAND: A. R. Bolton & Co., 3a St. Vincent St., Edinburgh 3.	*32035*

write to **ELCONTROL LTD., HITCHIN, HERTS.** *Hitchin 2411*

ELCONTROL

Essential for sampling and monitoring

HENDREY

Mercury Vapour Concentration Meter

Type E.3472

Measures concentration of mercury vapour present in air. Essential where quantities of mercury are regularly used or where danger exists of leakage of mercury vapour from apparatus.

Two sensitivities are available, at the touch of a switch, giving either full scale reading at a concentration of 770 micro-grammes per cubic metre of air or full scale meter reading at a concentration of 200 micro-grammes. Terminations are provided at rear for operation of a recorder to give continuous readings of concentration present.

Hendrey Relays

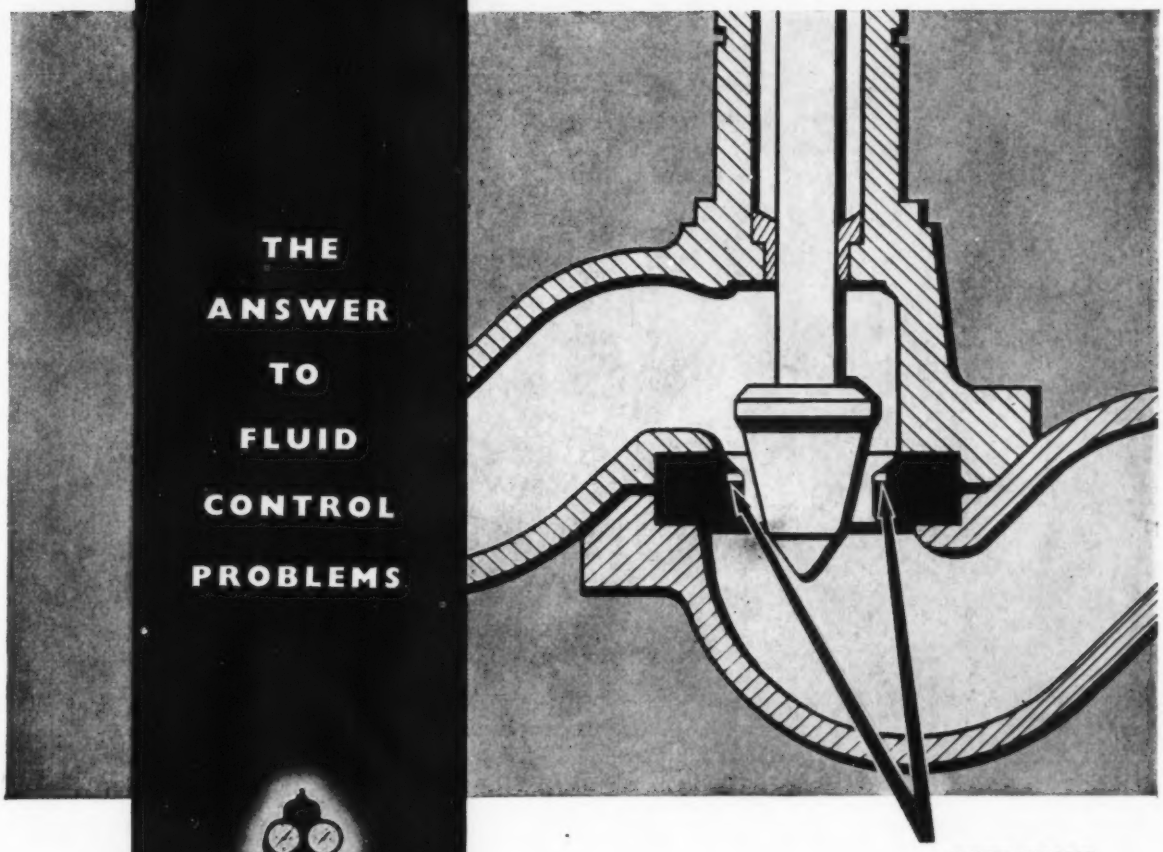
HENDREY RELAYS LTD · BATH ROAD · SLOUGH · BUCKS · Telephone: Burnham 609/611

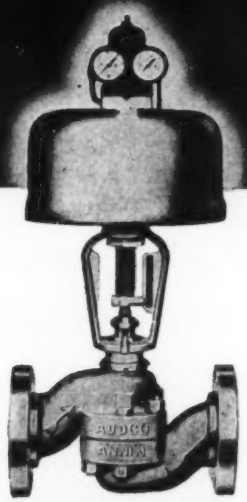
MANUFACTURING ELECTRICAL ENGINEERS · CONTROL AND LABORATORY APPARATUS

On Admiralty, Principal Ministries and Post Office Lists. A.I.D. and A.R.B. Approved

Circle 36 for further information

THE ANSWER TO FLUID CONTROL PROBLEMS





SOFT SEATS

Audco Annin Valves are recognised by Control Engineers and Valve Designers as the outstanding valve development of the past 25 years for the control of hot, cold, erosive, corrosive or viscous liquids.

Their unique design provides . . . .

- The finest shut-off available irrespective of pressure differential across the valve.
- With metal to metal seating the leakage factor is 0·01 per cent of full flow.
- Soft seats in either P.T.F.E.* or P.T.F.C.E.* provide absolutely tight shut-off.
- Seats may be inspected or changed easily and quickly without removal from the line.
- The faults and complications of swaged, screwed, pinned and welded seat mountings are eliminated.

'Stellite' faced seats can be supplied for arduous duties. Ceramic seats are also available.

Plugs of percentage, linear and semi-throttle characteristics in standard sizes or reduced trim available in a wide range of materials.

★ *Polytetrafluorethylene or Polytrifluorochloroethylene.*

AUDCO ANNIN Valves

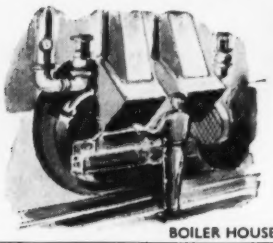
Standard range of valves up to 2500 ASA rating.

AUDLEY ENGINEERING COMPANY LIMITED, NEWPORT, SHROPSHIRE

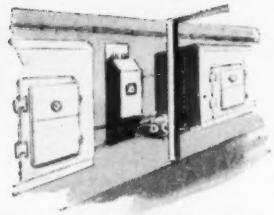
Circle 37 for further information

Rototherm

The DIAL THERMOMETER



BOILER HOUSES



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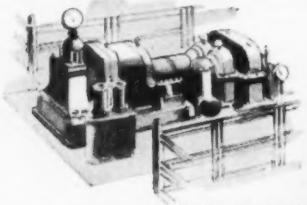

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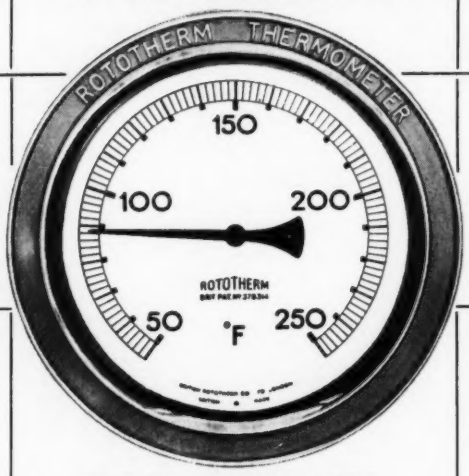

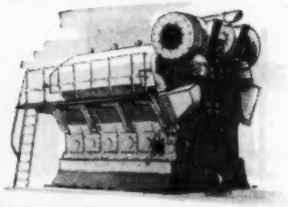

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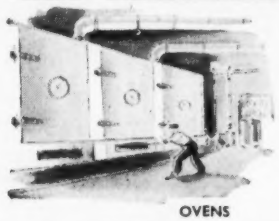

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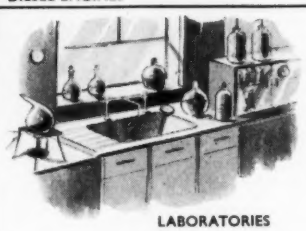

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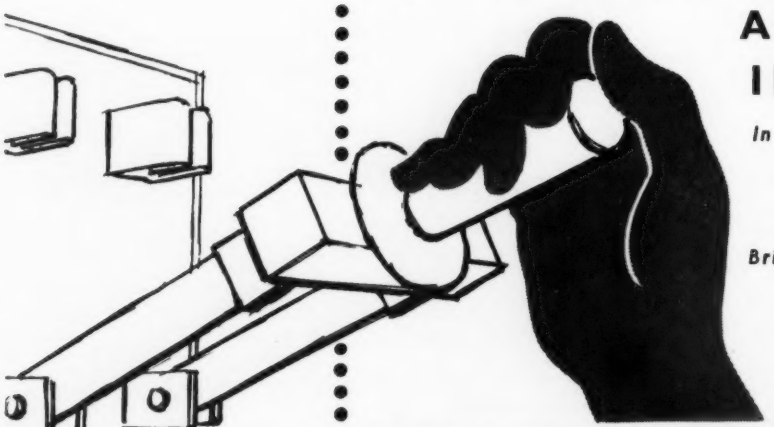

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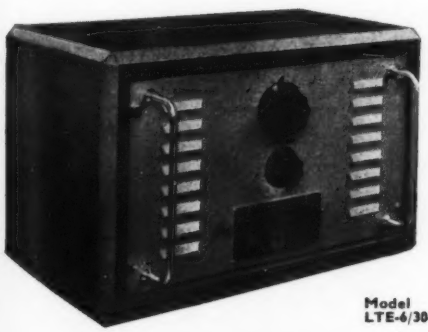

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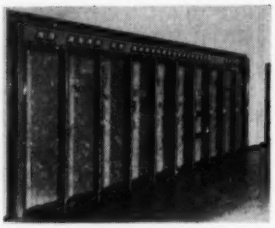

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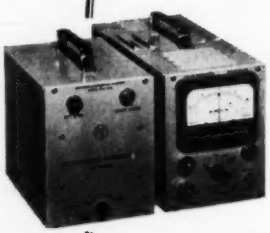

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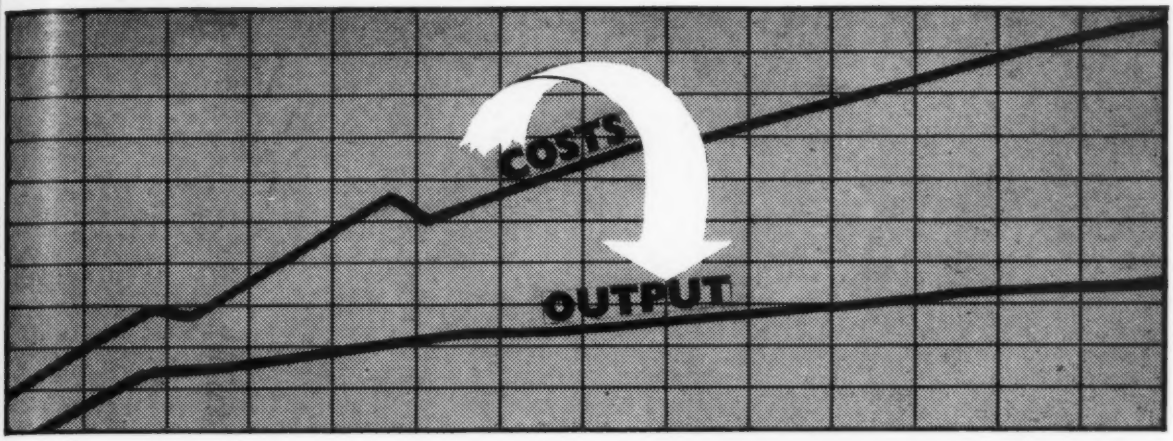

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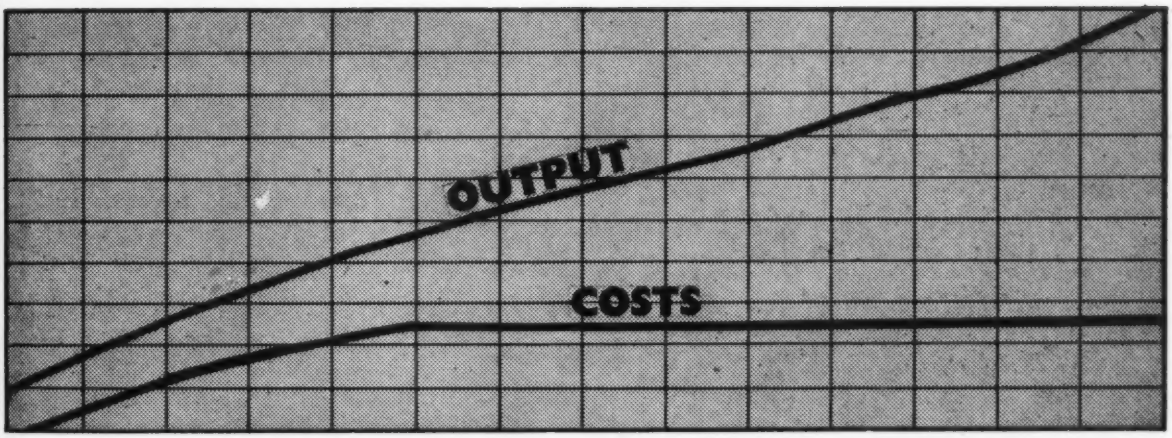

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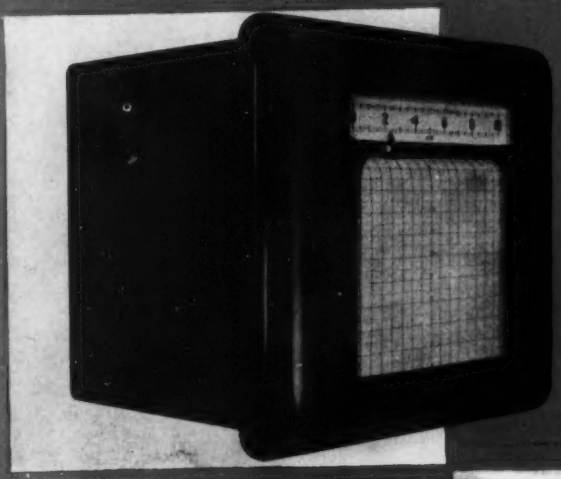

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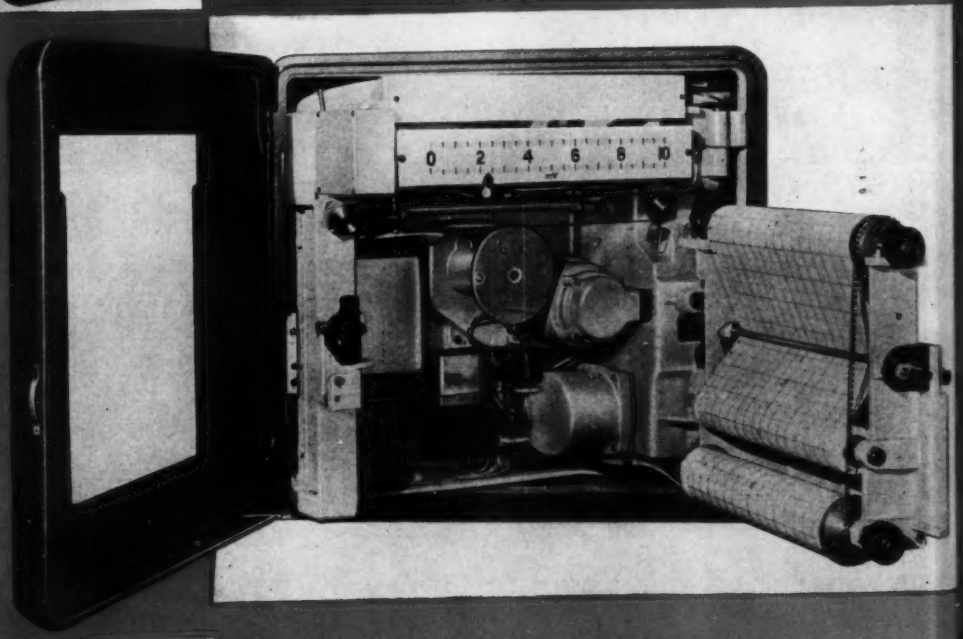

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INSTRUMENT Practice AUTOMATION & ELECTRONICS

Editor: J. T. Miller, B.Sc., F.Inst.P.

VOL. 13. No. 7

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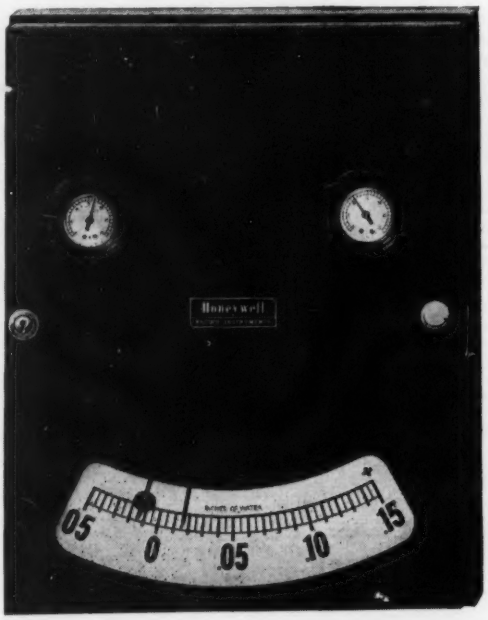

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INSTRUMENT Practice
AUTOMATION & ELECTRONICS

We regret that owing to the dispute in the printing industry, this issue of Instrument Practice appears later than usual and is unavoidably reduced in size.

COMMENTARY

Measurement The adjacent heading was suggested by a reference in Sir Harold Hartley's closing speech at the recent joint symposium on Instrumentation and Computation in Process Development and Plant Design. A physical condition cannot be controlled before it can be measured and it cannot be controlled accurately before it can be measured accurately. It has always been the policy of this journal to emphasise measurement and new methods of measurement, even against criticism that we are over biasing the content in favour of measurement as opposed to control. This viewpoint does seem to have some backing from Sir Harold who said in his speech: "The improvement of measuring techniques, their accuracy and sensitiveness, should have the highest priority, as they are at present the limiting factor in the development of control." Sir Harold also drew attention to remarks in the paper by R. E. Kalman, L. Lapidus and E. Shapiro. ("The Optimal Control of Chemical and Industrial Petroleum Processes.") Whilst discussing mathematical models in relation to the problem, the authors pointed out that cases can arise where the dynamics of the measuring elements pose more severe problems than the dynamics of the process. After a reasoned statement on the utilisation of plant data, the paper stated that "it is clear that ultimately the precision of control depends only on the accuracy of measurement".

A little reflection, of course, shows that the solution of increased accuracy in measurement is not likely to be very easy. To consider temperature alone, the present detecting elements: resistance thermometer, thermocouple, liquid expansion thermometer, etc., are of long standing and the industrial plant models have probably reached their maximum accuracy. The investigation into new methods will inevitably be costly and a heavy load for any particular instrument manufacturer to carry. The choice of some central organisation such as the British Scientific Instrument Research Association seems logical when the particular needs arise.

Household Words At the moment of writing this commentary a market report on the field for scientific instruments in Chile has just been received from the Export Services Branch of the Board of Trade (COM/16200). In passing it should be noted that for the purpose of the report, industrial measuring and control instruments are included under the general heading. One meets the phrase "Zeiss and Leitz have been household words in Chile for many years". One might be prompted to add "and not only in Chile". The tradition that the optical products of Leitz and Zeiss are paramount is one that dies hard. This is not to deny the quality of the instruments manufactured by these firms, which we all know is excellent, but our own optical industry is now producing equipment of, at least, the same quality, and one would like to see some of our own names as household words, thus rewarding the efforts of our optical companies.

Transistors Elsewhere in the issue will be found an account of some of the features of the recent International Transistor Exhibition and Convention. It is perhaps a reflection of our time that in a period of about ten years a component has emerged from the initial conception to the establishment of a specialised industry and is sufficiently important to warrant its own exhibition and convention. In addition, three scientists concerned with its initiation have been awarded the Nobel prize. The place of the transistor in the industrial sphere was brought out at Earl's Court and its potential applications could well be realised. There is just one thought—it is to be hoped that, in the wake of the exhibition, the word "transistorised" will not be applied indiscriminately as was the word "automation" some two or three years ago with the inevitable reaction.

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1S502	24	150	4	10	8	0.08
1S503	27	150	4	10	8	0.08
1S504	30	150	5	10	8	0.08
1S505	33	150	5	10	8	0.08
1S506	36	150	6	10	8	0.09
1S507	39	150	6	10	8	0.09
1S508	43	100	7	10	8	0.09
1S509	47	100	8	10	8	0.09
1S510	51	100	10	10	8	0.10
1S511	56	100	11	10	8	0.10
1S512	62	50	14	10	8	0.10
1S513	68	50	16	10	8	0.10
1S514	75	50	24	10	8	0.11
1S515	82	50	26	10	8	0.11
1S516	91	50	40	10	8	0.12

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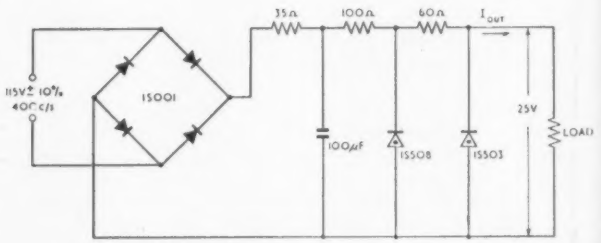

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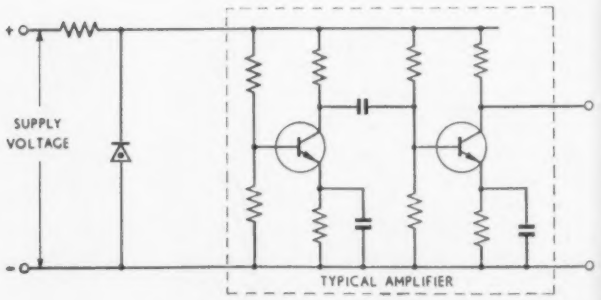

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Transistors

in Measurement and Control—3

h Parameters

By J. T. MILLER, B.Sc., F.Inst.P.

Fig. 1. Four terminal linear network

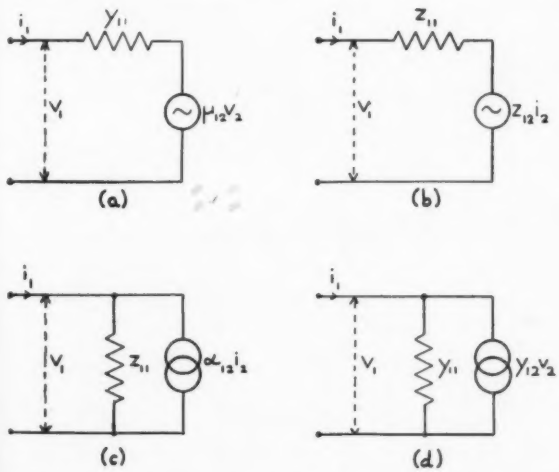

Fig. 2. Basic equivalent input circuits

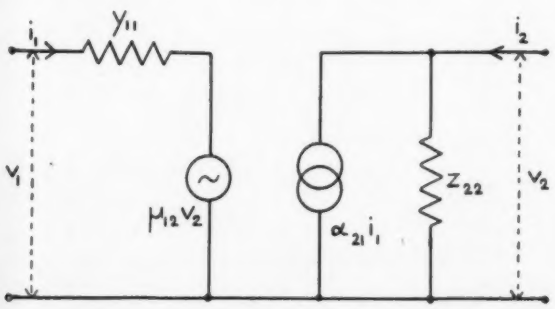

Fig. 3. Basic equivalent four terminal network

BEFORE proceeding to any consideration of the application of transistors, it is instructive to extend the conception of the equivalent circuit a little further. Whilst the transistor is a three terminal device in construction, the wealth of information existing on four terminal network analysis renders it convenient to examine the transistor in that light. Fig. 1 indicates the elementary block diagram of a four terminal network with i_1 as the input current, v_1 the voltage developed across the input, i_2 the output current and v_2 the voltage developed across the output. Fig. 2 shows four conceptions of the input circuit of a transistor[1]. In these y_{11} is the short circuit admittance, μ_{12} the open circuit reverse voltage amplification factor, z_{11} the open circuit impedance, z_{12} the reverse transfer impedance, α_{12} the short-circuit reverse current amplification factor, and y_{12} the reverse transfer admittance.

In Fig. 2a,

$$v_1 = \frac{1}{y_{11}} + \mu_{12} v_2 \quad \ldots\ldots\ldots\ldots (1)$$

In Fig. 2b,

$$v_1 = z_{11}\, i_1 + z_{12} i_2 \quad \ldots\ldots\ldots\ldots (2)$$

In Fig. 2c,

$$i_1 = \frac{1}{z_{11}} v_1 + \alpha_{12} i_2 \quad \ldots\ldots\ldots\ldots (3)$$

In Fig. 2d,

$$i_1 = y_{11} i_1 + y_{12} v_2 \quad \ldots\ldots\ldots\ldots (4)$$

Completing the four terminal circuit, we have a typical version in Fig. 3. α_{21} is the forward open circuit current amplification factor, and z_{22} the output impedance.

From Fig. 3,

$$v_1 = \frac{1}{y_{11}}\, i_1 + \mu_{12}\, v_2 \quad \ldots\ldots\ldots\ldots (5)$$

$$i_2 = \alpha_{21}\, i_1 + \frac{1}{z_{22}}\, v_2 \quad \ldots\ldots\ldots\ldots (6)$$

Replacing

$\frac{1}{y_{11}}$ by h_{11}, μ_{12} by h_{12}, α_{21} by h_{21} and $\frac{1}{z_{22}}$ by h_{22},

$$v_1 = h_{11}\, i_1 + h_{12}\, v_2 \quad \ldots\ldots\ldots\ldots (7)$$

$$i_2 = h_{21}\, i_1 + h_{22}\, v_2 \quad \ldots\ldots\ldots\ldots (8)$$

The h coefficients are termed hybrid or h - parameters. h_{11} is an impedance, h_{22} an admittance, while h_{21} and h_{12} are numbers.

Variations of the subscripts exist. For example, it may be desirable to identify the type of circuit—common base or common emitter and an additional subscript b can be added, e.g., h_{21b}. Alternative designations are i for input, r for reverse, f for forward and o for output. Then,

$h_{11b} = h_{ib}$
$h_{12b} = h_{rb}$
$h_{21b} = h_{fb}$
$h_{22b} = h_{ob}$

A similar set of designations can be produced for the common emitter circuit. In use shortened versions are often adopted: h_i, h_r, h_f and h_o.

The h parameters may be measured practically. A typical method has been described by J. Ewels[2]. Note, however, that they may also be derived from characteristic curves of a transistor provided these are obtained under the specified conditions. For example, Fig. 4 shows the collector current I_C plotted against collector bias V_C for various values of base current, common emitter conditions applying. From this family of curves h_{21} may be obtained since

$$h_{21} = \alpha_{21} = \frac{\triangle I_C}{\triangle I_B} \quad \ldots\ldots\ldots\ldots (9)$$

If p is the working point, the small increase $\triangle I_C$ of collector current I_C for a small increase of $\triangle I_B$ of base current I_B may be determined from the curve values.

At the same time, the value of h_{22} may be determined from the slope of the curve, e.g., $\frac{\triangle I_C}{\triangle V_C}$.

A second family of curves may be obtained with base current plotted against base voltage for particular values of collector bias V_C. In Fig. 5, h_{12} may be obtained from the relation $h_{12} = \frac{\triangle V_B}{\triangle V_C}$ and h_{11} from the slope $\frac{\triangle V_B}{\triangle I_B}$ of the curve at the working point.

Note that the generalised resistances used in equivalent currents, e.g., r_E for emitter resistance, r_B for base resistance and r_C for collector resistance may be expressed in terms of h parameters. For a common emitter circuit:

$$r_B = z_{11} - z_{12} = h_{11} - \frac{h_{12}}{h_{22}}(1 + h_{21}) \quad \ldots (10)$$

$$r_E = z_{12} = \frac{h_{12}}{h_{22}} \quad \ldots\ldots\ldots\ldots (11)$$

$$r_C = z_{22} - z_{12} = \frac{1}{h_{22}} \quad \ldots\ldots\ldots\ldots (12)$$

Typical values of the h parameters are of the order shown in the following table:

$h_{11} = 2{,}000$ ohms
$h_{12} = 600 \times 10^{-6}$
$h_{21} = 50$
$h_{22} = 25$ μmhos.

The conception of h parameters may be extended to transistors in cascade. For two transistors in series we have the following relations:

$$h_{11} = h'_{11} - \frac{h'_{12}\, h'_{21}}{1 + h'_{22}\, h''_{11}} \quad \ldots\ldots\ldots (13)$$

$$h_{12} = \frac{h'_{12}\, h''_{12}}{1 + h'_{22}\, h''_{11}} \quad \ldots\ldots\ldots\ldots (14)$$

$$h_{21} = \frac{h'_{21}\, h''_{21}}{1 + h'_{22}\, h''_{11}} \quad \ldots\ldots\ldots\ldots (15)$$

$$h_{22} = h''_{22} - \frac{h''_{12}\, h''_{21}}{1 + h'_{22}\, h''_{11}}\, h'_{22} \quad \ldots\ldots (16)$$

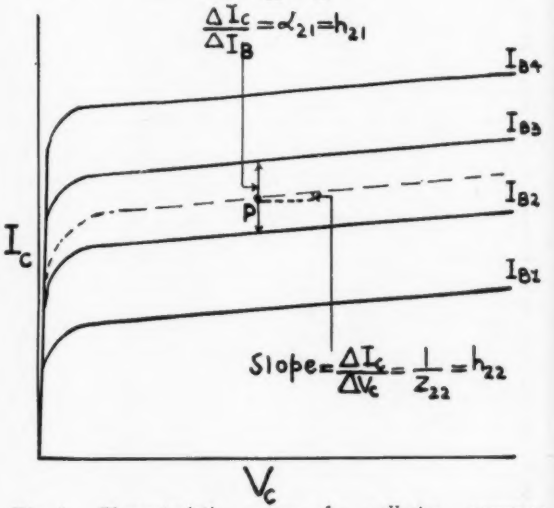

Fig. 4. Characteristic curves for collector, common emitter connection

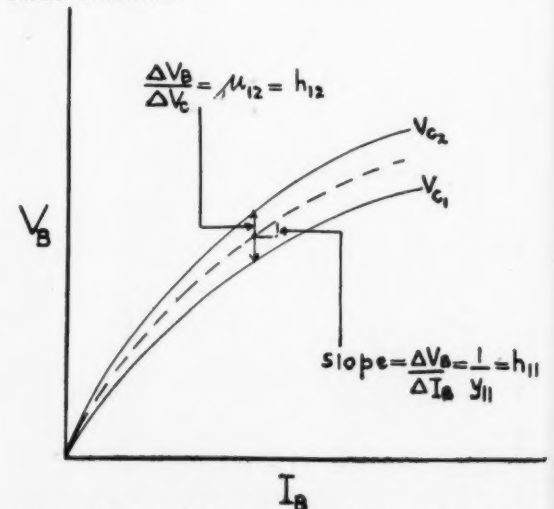

Fig 5. Characteristic curves for base, common emitter connection

Finally, the case of a transistor with finite external impedances must be considered. The basic arrangement is indicated in block fashion in Fig. 6. The source impedance is z_s and the load impedance is z_L. z_i and z_o are the input and output impedances respectively.

The following relations may then be deduced:

Input impedance =

$$\frac{v_i}{i_1} = h_{11} - \frac{h_{12}\,h_{21}}{h_{22} + z_L} \qquad \ldots\ldots\ldots\ldots (17)$$

Output admittance =

$$\frac{i_2}{v_2} = h_{22} - \frac{h_{12}\,h_{21}}{h_{11} + z_s} \qquad \ldots\ldots\ldots\ldots (18)$$

Current gain =

$$\frac{i_2}{i_1} = \frac{h_{21}\,z_L}{h_{22} + z_L} \qquad \ldots\ldots\ldots\ldots (19)$$

Voltage gain =

$$\frac{v_2}{v_1} = \frac{-\,h_{21}}{h_{11}\,z_L + h_{11}\,h_{22} - h_{12}\,h_{21}} \qquad \ldots\ldots\ldots (20)$$

The open circuit values are for input impedance and output admittance:

Input impedance

$$z_{11} = h_{11} - \frac{h_{12}\,h_{21}}{h_{22}} \qquad \ldots\ldots\ldots\ldots (21)$$

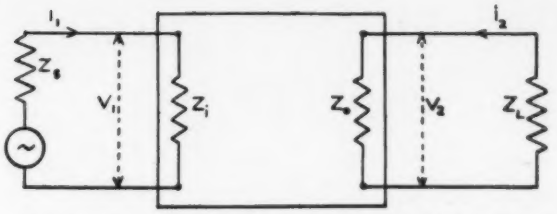

Fig. 6. Four terminal network and external impedances

Output admittance

$$y_{22} = h_{22} - \frac{h_{12}\,h_{21}}{h_{11}} \qquad \ldots\ldots\ldots\ldots (22)$$

Comparing (17) with (21) and (18) with (22), the significance of z_s and z_L can be noted in the second terms.

Future Articles

This article concludes the introductory series. Future contributions by specialist authors will deal with particular applications.

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MASTEROTOR Control Unit

IT is a recognised fact that without the long production runs encountered in U.S. manufacturing plants, we in this country cannot attain the same overall standard of automation without huge unwarranted capital expenditure. Only where continuous production or processes are carried out is it practicable to allocate floor space and special machines.

Pneumatics and hydraulics, however, have enabled the automation engineer to design transfer mechanisms, automatic feeds and tool controls which give a reasonable amount of flexibility compared with mechanical devices, thus enabling him to convert the sequence and timing of his devices to suit varying components and attain remunerative automation on short runs or batch production.

The conventional method of controlling pneumatic or hydraulic operations has been by the use of solenoid valves and cam-operated switches with resultant high maintenance costs and difficulties in setting up for various operations.

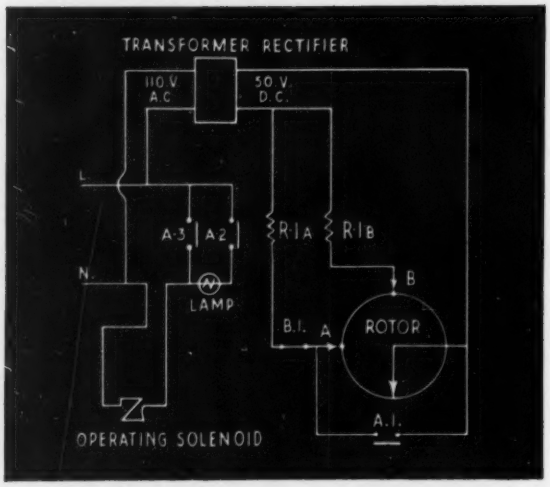
The Automation Division of Industrial Guarding Equipment Ltd. have recently developed the Masterotor unit which has been designed particularly for the control of automated tooling in power presses. The unit gives flexibility where short tooling runs mean frequent resetting of the control system. Its advantages have since been recognised for the control of short processes and batch production on machine tools.

The standard unit can be used with any machine where the movement of the component through its operations and the control of the machine is initiated by a series of electrical circuits, making and breaking at the required point in the machine cycle.

It provides means so that these circuits can readily and easily be varied to be made and broken at any given point in the machine's cycle relative to any particular operation requirement.

It provides means so that an additional number of circuit controls can easily be added to the master control at any time.

The unit consists of a rotary switch, which is rotated either by mechanical or other means by a moving member of the machine, such as a crankshaft, or rotated by a synchronous motor controlled by the machine, so that the switch makes one complete revolution for every one complete cycle of the machine. The switch is



Circuit of Masterotor

so designed to close one pair of contacts at each two degrees of rotation. These contacts are connected to a series of plug sockets numbered to correspond with the appropriate position of the rotor. It will be seen, therefore, that by plugging in to socket number two, it can be arranged that an electrical current will flow momentarily through these wires as the rotor passes number two contact on the master switch, or in other words, as the machine completes two degrees of its cycle.

It is required that this current may be held on to initiate some work by electrical, pneumatic or hydraulic means, for a certain period of the cycle.

In order to achieve this, the master switch is made to control a series of monitors, one monitor being required for each particular control circuit. These monitors each consist of one relay with a normally closed contact and one with a normally open contact, wired as shown in the circuit diagram.

It will be seen that if plug A of the monitor is inserted in any numbered socket, that, at that particular position in the machine cycle, the circuit will be completed to energise relay coil R.1A. This closes the contacts A.1 beyond that particular set of contacts. The circuit to initiate any required operation being made by separate contacts on relay R.1A. This enables a high voltage circuit to be used for operating purposes, whilst retaining a low voltage for the operation of the unit itself.

It will also be seen that by inserting plug B of the monitor in any numbered socket, that, at that particular position in the machine cycle, the circuit will be completed to energise relay R.1B. This opens the contacts B.1 which break the circuit through relay R.1A and the operating circuit.

Thus plug A determines where the operating circuit is closed relative to the machine cycle, and plug B where the operating circuit is opened relative to the machine cycle. It can be seen, therefore, that with a number of monitors, a number of operating circuits can be controlled, making and breaking at any given point in the cycle of the machine. Also by moving the plugs into different sockets, their periodicity and frequency can be easily and quickly changed. This enables the one unit to be readily adapted to control different operations and tooling in the same machine, or even to be changed to different machines.

Two standard models of the unit are available, the specifications of which are as follows:—

Type 180/8

Commutator has 180 segments giving a selection for ON and OFF positions every 2° intervals of crankshaft cycle.

The selector panel has 180 corresponding sockets numbered 2 to 360.

There are eight monitors for external control circuits, using Londex relays as standard. Other makes of relays can be supplied against special requirements at extra cost.

Input voltage can be 230 V or 110 V. Separate tappings are provided on the transformer which gives an output of 72 V a.c. to a germanium type rectifier giving an output of 50 V d.c. to the rotor and control system. The input voltage is connected directly to the indicator lamps and the external circuits.

Eight special Niphon plugs and sockets enable the external circuits to be connected to the control system. Offset plugs ensure correct phasing if external circuits have another source of supply.

An extra plug and socket is provided, connected to a dummy selector socket, to enable an external interlocking switch to be connected in series with the OFF. This enables an operation to be controlled after the rotor has stopped.

The commutator is robustly constructed in dustproof sheet metal case, and driven by chain and sprocket as standard.

The control panel has dustproof door with car door type lock.

Type 72/6

As Type 180/8, but commutator has only 72 segments, giving a selection for ON and OFF positions every 5° intervals of crankshaft cycle. Six external circuits instead of eight can be controlled.

The outstanding feature of the unit is its extreme simplicity with only one moving part, i.e., the rotor arm carrying the commutator brushes.

If one compares the comparative speeds of rotation with generators or motors one can appreciate that the brush life is infinite. The principle of the unit is readily understood by maintenance electricians and maintenance is negligible. The only replacement during one million operations on test being a visual indicator lamp.

An example of the Masterotor in use is given by one of the leading motor car manufacturers, where it is used to control a double-acting press at the start of an automated press line producing car door panels. The press is fitted with automatic blank loader at the front, and automatic take-off unit at the back with turn-over unit presenting the panel to a conveyor to the next press. The tools have built-in, pneumatically-operated locating gauges, lifters, ejectors and spray lubrication.

(*Continued on p.* 735)

A symposium on the optical pyrometer temperature scale, sponsored by the Heat Division of the National Bureau of Standards and the High Temperature Chemistry Group of Argonne National Laboratory, has answered many questions arising in high temperature standardisation, and in the calibration, use, and manufacture of optical pyrometers. Discussions centred on present temperature measurement techniques and instruments, and the use of the temperature scale beyond 4,000°K.

SYMPOSIUM ON THE

OPTICAL PYROMETER TEMPERATURE SCALE

TO facilitate the exchange of information and ideas on high temperature pyrometry, a symposium on the optical pyrometer temperature scale was held at the National Bureau of Standards, 23rd-25th October, 1958. Sponsored by the Heat Division of the Bureau and the High Temperature Group of Argonne National Laboratory, this symposium concentrated on present temperature scales and calibration practices, recent improvements in optical pyrometer techniques and instruments, and the possible use of the temperature scale beyond 4,000°K. Chairman of the symposium was C. M. Herzfeld, chief of the Bureau's Heat Division.

In the last few years, the interest in high-temperature measurements has created a demand for optical pyrometers capable of greater precision and accuracy. This need has raised many questions about procedures for realising the International Temperature Scale at high temperatures (above 1,063°C) and about the calibration, use, and manufacture of optical pyrometers.

Trends in the Bureau's work on optical pyrometry were outlined at the beginning of the conference by Dr. Herzfeld. He pointed out the necessity of improving methods of temperature measurement in the range 800°C to 4,000°C under ideal conditions. Here accuracy, precision, and convenience of operation need further improvement. An extension of methods for measuring temperatures under ideal or approximately ideal conditions in the range 4,000°C to 10,000°C is also required. In addition, improvements in temperature measurement under non-ideal conditions, such as in flames and complicated systems, are needed together with more fundamental research leading to new and better ways of measuring temperature.

To form a basis for further discussion, a summary of the theory of optical pyrometry was presented by H. J. Kostkowski, of the Bureau, and G. H. Winslow, of the Argonne National Laboratory. The various assumptions concerning pyrometer calibration were carefully analysed. The importance of the relative visibility function of the observer and the adequacy of using a tungsten strip lamp rather than a black body for temperatures above the gold point were emphasised.

This paper was complemented by a discussion of the calibration of the National Bureau of Standards' standard pyrometer, presented by H. J. Kostkowski and R. D. Lee. A recent attempt to realise the International Temperature Scale with maximum precision by a careful primary calibration was described. The standard optical pyrometer, a disappearing filament type, is calibrated at the gold point by sighting on a black body maintained at the freezing point of gold, one of the primary fixed points on the International Temperature Scale. At higher or lower temperatures the calibration is achieved by sighting at a tungsten strip lamp through rotating sector discs and using the Planck radiation law to calculate the unknown temperature. This calculation also involves the mean effective wavelength, which is determined by the filters in the optical pyrometer and the relative visibility function of the observer. Greater reliability was achieved in this calibration by determining independently the visibility function of each observer rather than using an average visibility curve as is done in most standard laboratories. It is felt that the results of this primary calibration are about the best one can expect from visual optical pyrometry, with uncertainties in the calibration going from $\pm 0{\cdot}5$°C at the gold point to ± 4°C at 2,400°C. An international comparison of strip lamps reveals that this optical pyrometer scale agrees with the mean scale of the national laboratories

of Canada, West Germany, and East Germany to within ±1°C in the range compared (800°C to 2,200°C)[1].

The procedure employed at Argonne to establish the temperature scale in the range of 1,000°C to 2,500°C was discussed by R. J. Thorn and G. H. Winslow. The starting point for the calibration was the freezing point of copper, which has been determined as 1,083°C on the 1948 International Temperature Scale. Above the freezing point of copper a black body constructed of tungsten, contained in a vacuum and heated inductively, was employed as a light source. Some advantages of using a black body rather than a tungsten strip lamp were discussed. Effective wavelengths, calculated from the measured transmissions of the pyrometer red filter and the standard visibility function, were presented. The National Bureau of Standards and Argonne National Laboratory optical pyrometer temperature scales agree within 1°C at the gold point, but differ by 4°C above 1,600°C. It is suggested that the most likely source of the difference lies in the effective wavelengths.

The basic limitations on the accuracy of optical pyrometry were discussed by D. R. Lovejoy, of the National Research Council of Canada. An estimate of the errors arising in primary standard pyrometer calibrations and in secondary standard strip lamp calibrations was shown to agree with the results of a recent intercomparison of secondary strip lamps. An evaluation of a carbon arc, accepted as a useful secondary standard at 3,514°C, showed that in this region the effect of the uncertainty in effective wavelength is greater than all other sources of error combined. Even though very precise work was involved in determining the platinum point at 1,769°C, metal freezing points seem to offer little advantage over the strip lamp as secondary standards. This paper concluded with a discussion of the errors in calibrating non-standard pyrometers, showing that good commercial pyrometers can be calibrated with a precision comparable to that of primary standard pyrometers if the lamp current is calibrated directly rather than through the internal potentiometer and scale.

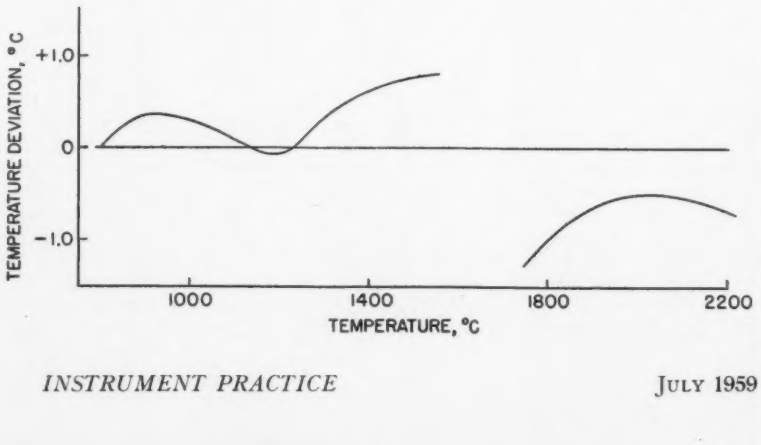
R. D. Lee, of the Bureau, discussed the procedures used in calibrating optical pyrometers and tungsten ribbon filament lamps submitted to the Bureau. Temperature comparisons are made with the N.B.S. standard pyrometer from 800°C to 3,800°C. In calibrating optical pyrometers, a tungsten ribbon filament lamp is used as a temperature source up to a brightness temperature of about 2,400°C, and a zirconium arc and carbon arc to temperatures of 2,800°C and 3,800°C, respectively. Since the brightness temperature of a non-black body is determined in part by the red filter glass of a pyrometer, corrections are made for test pyrometers with different transmission characteristics. The estimated uncertainty of the calibration below 2,800°C is based on experience with a number of instruments rather than on the specific data of a given instrument. The standard deviation, with respect to the International Temperature Scale, of pyrometer and strip lamp calibrations is about ±1°C from 800°C to 1,500°C, ±2°C from 1,500°C to 2,000°C and increases to about ±6°C at 2,800°C.

Methods of precise temperature measurement in determining the properties of refractory materials at the Los Alamos Scientific Laboratory were described by M. Bowman. Measurements of rapidly changing temperatures and of small temperature changes are required for the technique employed in measuring thermal diffusivity. These temperature changes are obtained by means of a multiplier phototube and a high-speed recorder.

L. Brewer, of the University of California, concentrated on the adequacy of the temperature scale in the determination of thermodynamic properties. The adequacy depends on the point of view, that is, whether the second or third law of thermodynamics is used in the calculation of thermodynamic variables. Brewer suggested that the accuracy requirements for a temperature scale to be used with the second law are extremely rigorous. In a third law method, where the heat of formation and the temperature are proportional, an uncertainty in the absolute temperature of 0·5 per cent is a reasonable goal. This paper also reviewed at some length past problems arising with N.B.S. calibrations of certain optical pyrometers. Greater care in the use of these instruments and recent improvements in calibration practices seem to have eliminated these problems.

H. F. Stimson, of the National Bureau of Standards, discussed the relation of the International Temperature Scale to the Thermodynamic Scale. This paper included a report on the present state of agreement between the two scales and work being carried out to achieve a better knowledge of the difference between these scales.

(*Continued on p. 732*)



Results of the 1958 international comparison of strip lamps by the National Bureau of Standards and the national standards laboratories of Canada, West Germany, and East Germany. The difference between the Bureau's calibration and the mean of the other laboratories is 1·3°C or less.

Computers and the Electronic Office

Part 3. Despatch and Clerical Procedures

By R. H. WILLIAMS, A.I.B., F.Inst.D.
Managing Director, Computer Consultants Limited

This month it is intended to deal with the use of computers for the despatch of goods and the clerical procedures following this, and a fictitious motor car manufacturer will be taken as an example.

THE procedures being considered start with the despatch of either completed motor cars or spare parts relating to the cars, or possibly sub-assemblies, such as complete back axles, etc., which are made up of several individual parts.

In the procedures last month, each complete portion of the car, and the cars themselves, were exploded into their individual component parts. In the despatch of finished goods the price of the individual component parts which make up the whole item will be examined.

Although each item, which makes up a motor car, will have its own price, both for stocktaking purposes and for selling, the price of the complete car will vary from the total cost of its components, as will the price of, say, the back axle vary from the cost of the component parts, which make up the axle. In some cases the price of the whole will be less than the total of the individual parts, while in others, because the cost of assembly has to be taken into account, the price of the whole may be greater than the cost of the component parts.

Processing Orders

The request for the despatch of the goods, whatever they may be, will reach the manufacturer in a variety of ways. It may be a telephone message, a telegram, a telex message, a letter, an official order form from the company ordering, or a properly completed order form supplied by the motor car manufacturer himself. This latter case will be a rarity, and the system must be arranged to cater for the worst condition—possibly an order scribbled on a piece of brown paper—and to take into account any special instructions which are required to conform with the procedures of the organisation ordering. For example, invoices may be required to be despatched in a varying number of copies, and possibly to a different address from that to which the goods are to be sent. There are a variety of ways of tackling this particular type of work, and the one outlined is merely one way of doing this job.

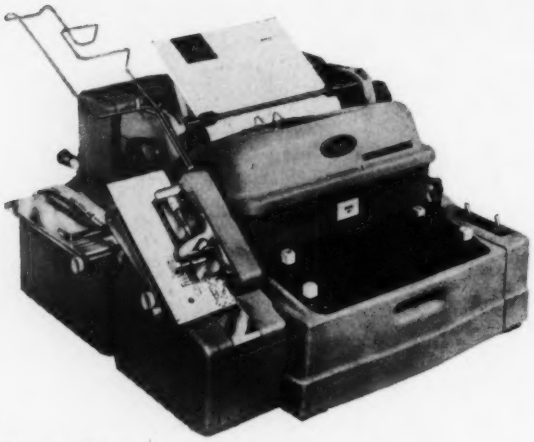
It might be very suitable for a particular organisation, and it might be highly unsuitable for another, where various individual anomalies make it unworkable.

Because the example taken is a motor car manufacturer, it is reasonable to assume that he deals only with certain appointed agents, and that the number of agents is relatively limited, for example, 500 people. These in turn act as both wholesalers and possibly retailers to a very large number of people, the public at large.

When an order is received, the important thing is to despatch the goods, or, alternatively, to advise the person ordering when they will be available, and to arrange to take the appropriate action to ensure that they will be forthcoming, if it is indeed within the policy of the company to wish to continue to supply them.

When the orders are first received, they must be edited by clerks to ensure that they indicate clearly the customer for whom the order is intended, and that they also indicate the reference number of the particular item required, as well as the quantity.

So as not to process documents unnecessarily, it will be as well at this stage to have some system of stock levels readily available on a daily basis, which will enable the clerks editing the order to note immediately if the item they are dealing with is known to be out of stock. This will merely be a preliminary editing, and as the orders build up during the course of the day, an item which was in stock earlier may well be out of stock later in the day, and this will not be discovered until the documents as a whole are processed.



Flexowriter

Use of Edge Punched Cards

The edited documents are then passed to the typing room, and here the work could well be carried out on Flexowriters using edge punched cards to type the customer's name and address.

In order to use these edge punched cards, it will be necessary to pull them from the file and to return them to the file after completion of the work. Because the number of customers is relatively limited, this would, in this instance, probably be an economic procedure, but if the number of customers is very large, it might not be so.

Not only does the pulling of the cards and the automatic printing from them speed up the typing operation, but it also ensures that this information, including the customer's reference number, is in fact correct.

At this stage, the typist will be producing hard copy of the despatch document in the form of a "set" on the Flexowriter at the same time as she is punching the paper tape.

She will indicate the reference number, alphabetical description and quantity, as well as the price of the goods on this despatch document, but the price will not, at this stage, be extended.

It will also be necessary to have a code inserted in the customer's name and address portion of the form, which will at a later stage be read by the computer, and used to tell it how many copies of the invoice should be produced, and also whether these are to be sent to an address different from that to which the goods were despatched.

The set of despatch documents produced by the typist can take a variety of forms, depending upon the circumstances, but in this instance it will be assumed that one copy will be the despatch note itself to be posted under cover; the second copy will be a despatch note to the receiver of the goods; the third copy for office file purposes, the fourth a form of receipt for the goods, to be returned to the company, and the fifth an acknowledgment authority for the warehouse to issue the goods.

The stage has now been reached when documents are being prepared to enable the goods to be despatched, and also punched paper tape has been prepared, which will later be processed and which contains all the basic required information.

It is most important that this basic information should be correct and it will have to be carefully checked. Various methods of checking are available, such as the use of punched paper tape verifier and the repunching of cards, etc., but basically one feels that in a case such as this the verifying can best be done visually, particularly when the most important portion has been produced from records which are already known to be correct, i.e., the edge punched cards.

To enable the checking to be done visually, the typist must put together the documents she has typed, the edge punched card and the original basic order. If errors are discovered, then the documents will have to be retyped and the tape marked to indicate that there are errors, and that particular portion of the tape requires to be isolated.

When the goods have been despatched then arrangements can be made to process the paper tape through the computing system, and produce the other records and documents which must be despatched in order that payment may be received.

Stock Processing

The first item to be processed will be the stock. The computer contains details of the stock on hand on a reel of magnetic tape (see Part 2). Receipts of stock will be processed against this tape and each day details of sales and withdrawals must be processed against the tape, leaving a net stock on hand position on the tape.

If the stock is not brought up to date documents may be processed when the stock is not on hand. But because goods were not actually available the documents would not have been sent, and it merely means that a portion of the work must be re-processed.

It is possible to arrange to update the stock position during the day. This, however, would involve considerable clerical work, and provided a list of stock on hand at the close of business each day is given to those editing the orders first thing the following morning, ready for that day's work, then with practice and knowledge of the particular trend of an item of goods, this state of affairs should not happen often. It is a legitimate business risk, as opposed to the extra clerical work and costs which would otherwise be involved.

Having used the computer to produce and update the stock on hand position, then this will be printed out daily, and available for the following day's work both for warehousemen and for those editing the orders.

Invoice Despatch

The next task is to despatch invoices. The format will be very similar to the despatch documents, which are already on tape, with the additional feature of an extension of the prices and the application of any discounts which are to be given.

The invoices can then be printed and despatched, the computer, as mentioned, taking into account any particular instruction which requires that goods should

be sent to one address and the invoice, in either duplicate or triplicate, to another address.

The tape which contains the record of the invoice details will periodically be posted against the customer's ledger account, and as a result of this, periodic statements of account will be prepared and despatched. This work will, of course, also note cash received.

These ledger accounts can be balanced from time to time by the computer and Trial Balances agreed with the Sales Ledger and the General Ledger Accounts.

When it comes to putting into practice a system such as outlined above, peculiar characteristics of the organisation concerned will very often upset the theoretical plan.

An example of this would be in the production of despatch documents stage if the stock was a very varied one and held at several different points.

There are two alternatives. One is to circulate the requisition to the warehouse and collect the items of stock together for packing and despatch at one central point. The other is to produce the despatch documents in such a way as to enable them to be broken down and sent to the individual warehouses where the stock was located.

If this were done, it would result in the receiver of the goods obtaining several pages of despatch documents instead of the one or two pages which his order would normally occupy. This might not be acceptable to him, and as the ultimate customer's requirements must be borne in mind, the system as a whole would become unacceptable without modification. It should, however, be mentioned that the basic inception of an integrated computer data processing system does call for considerable changes to be made to the existing method of carrying out the work.

Without in any way seeking to upset the new system, people will be inclined to be dogmatic about what can be done or what is acceptable, basing their opinions upon past practices and before one finally comes to the conclusion that this or that cannot be done after all, it becomes necessary to look very carefully at the criticisms.

This is, of course, possible and we have described one way of doing this earlier in this article, but it is not generally as simple as one would make it out to be.

In the first place when carrying out operations in an office it becomes necessary, for procedural reasons, to cut down the size of the batches of work being dealt with, in order that they can become manageable in other respects, for example, so that they can be balanced with some other figures, or so that the other operations that are to be done on the goods themselves can be handled.

This inevitably produces very short runs of paper tape which can be troublesome, and also takes on occasions very little account of errors that are subsequently found and which have to be corrected with a disproportionate amount of trouble.

The original error incidence in a computing system is a serious factor which can undoubtedly best be dealt with systemwise at the initial input stage.

This aspect will be considered next month together with some of the later work of the system, the supplying of statistics for management.

BOOK REVIEWS

Process Dynamics

By Donald P. Campbell. John Wiley and Sons, £4 4s. 0d. 316 pages.

In this volume the author has set about the task of investigating the dynamics of typical production processes and reducing them to the transfer function form, familiar to servo engineers. Having produced and investigated the transfer function of a particular process, a method of control can be devised by using established servo-mechanism techniques.

Processes are divided into three main groups—the kinematics of materials handling, fluids in motion, etc.; thermal and chemical processes; and nuclear processes. In this book, only the first two groups are dealt with, since the author considered the nuclear processes to be of such complexity that they warrant a separate volume.

The author is very successful in illustrating and emphasising the fact that all processes, however complicated, will yield to the same basic techniques of mathematical analysis. The use of block and signal diagrams as essential aids to analysis is well bought out and liberal use is made of such diagrams throughout the text although, in some cases, the illustrations show the results of having been reduced from a much larger size. Table 4 in particular is almost unreadable without a magnifying glass.

Electrical circuit analogues are used in the analysis of fluids in motion and in some sections of the chapter on thermal process dynamics, but little attention is given to the application of analogue computers to solving control problems. Although not every firm owns such a computer, time on these machines can be bought comparatively cheaply and the effects of parameter variation studied easily and quickly.

Alas, as in so many books nowadays, the index is poor and occupies little more than two pages for a book of over three hundred pages.

A selection of problems is included, some of which have, as the author enigmatically remarks, "no known solution" and are included so that the student can learn to distinguish problems which are not worth solving !

Unfortunately, Dr. Campbell died before completing the text and the book was edited for publication by another hand. This may in some measure account for two features of the book which the reviewer found particularly irritating.

The first is the tendency to convey an excess of information to the reader in a series of short disjointed sentences which could, with a little application, have been connected to give a flowing narrative. As an example, the following section is taken from Chapter 4 on Thermal Process Dynamics :— "Many different kinds of heat exchanger occur. In some, the fluid flow is concurrent, in others countercurrent. Still others have baffles and multiple tubes so that cross flow occurs. Some are used as boilers or evaporators, others as condensers". One is reminded of the programming of information into a computer which, although

a phenomenally efficient machine, is unreasoning and devoid of the power of creative thought. Could it be that modern teaching engineers, of which Dr. Campbell was an example, tend to regard their students only as machines to be fed with predigested bits of information?

The other feature is a preface which attacks process engineers in general for concentrating on instrumentation while neglecting to study the plant itself. This criticism is long out of date so far as this country is concerned, since firms like I.C.I. have for many years been applying frequency response techniques to the study of process control. Dr. Campbell also resorts in this preface to such plaintive academic accusation as, for example, "Nor do they (the designers) consider that a flame reactor, even though it has the basic function of producing a chemical, is nevertheless an acoustic loudspeaker". One wonders whether the designers have felt the need of this particular analogue and if loudspeaker engineers have ever paused to consider . . ?

However, these criticisms apart, the book admirably fills a gap in the literature of process control and further emphasises the fact that control engineers and servo engineers are studying identical problems and can use identical basic techniques.

C. B. FLINDT

The Theory and Design of Magnetic Amplifiers

By E. H. Frost-Smith. Chapman and Hall. £3 15s. 0d. 487 pages.

Dr. Frost-Smith's association with Magnetic Amplifiers began at the Royal Aircraft Establishment during the last war and his subsequent researches are familiar to all students of the literature on this subject.

This book, which is the first of a new series on Automation and Control Engineering, is intended to provide sufficient information to enable any competent engineer to understand and design magnetic amplifiers. The treatment of the subject is reminiscent of the older classical books on Electrical Machine Design, commencing, as it does, with fundamentals of electromagnetism and concluding with fully worked out designs for typical systems. In between, the author discusses in detail the theory of all the significant variations of magnetic amplifiers (including high speed amplifiers and magnetic modulators) and their application to control systems.

Dr. Frost-Smith is well aware of the limitations of theory when applied to the study of such non-linear devices as saturated ferromagnetic cores and selenium rectifiers and he does not hesitate to draw the reader's attention to the fact that, on many occasions, practical experience is the best guide to design. It is rather a pity, therefore, that no test figures are given to show how the amplifiers designed in Chapter 13 performed in practice, so that the reader could estimate the margin of error to be allowed in such calculations. Despite this minor defect, however, Chapter 13 on Construction and Design is an invaluable section of the book, particularly to the control engineer who may occasionally be faced with the necessity for designing an experimental amplifier to meet specified conditions. It is interesting to note also that, even in these days of standardisation, the chapter on Magnetic Amplifier Applications contains examples working on frequencies of 50, 333, 400, 500 and 1,100 cycles per second.

The book has a short but well chosen bibliography which is of considerable help to the beginner, who may be over-awed by the mountainous mass of literature which the subject has accumulated in the past ten years. It also has a comprehensive list of symbols which is an absolute essential in any book of this nature in which subscripts abound.

On the whole, this volume can be recommended strongly, both to the engineer unversed in the art and to the expert who may need to brush up his basic theory on occasion.

C. B. FLINDT

The Transistor Era

Edited by C. C. Gee and C. A. Marshall. Heywood and Co. Price 6/-.

The subtitle of this publication is "A guide to transistors and associated semiconductor devices" and it provides a commercial survey of world production of semiconductor devices and gives the names and addresses of some 124 manufacturers in 15 different countries.

The technical characteristics of the different types of semiconductor devices are given together with an overall picture of semiconductor development and an indication of the relationship between the numerous groups of devices now available.

There is a Buyers' Guide to transistors and associated semiconductor devices and accessories, which also covers special manufacturing plant used in semiconductor device manufacture.

(Continued from p. 728)

The present techniques employed in the design, manufacture, and calibration of commercial pyrometers were outlined by K. A. Walch and R. C. Stroud, of Leeds and Northrup, and by Paul V. Bollerman, of the Pyrometer Instrument Company.

A brief summary of work going on at the Bureau on photo-electric pyrometers was given by C. P. Johnson and D. Erminy[2]. The first model of the N.B.S. photo-electric pyrometer has a sensitivity of 0·1°C at the gold point and a spectral band width of only 100Å. These features together with its objective character make it an attractive instrument. However, the measurement of brightness temperatures to a precision of 0·1°C introduces many difficult problems involving lens aberration, scattered light diffraction, and the stability of light sources. These must be investigated in great detail before the photo-electric pyrometer can be considered a reliable accurate instrument.

Concluding the discussion of high temperature measurements was a report on measurements of the colour temperatures of a number of stars by E. Kron, of the Lick Observatory, University of California. This work may have some future bearing on the calibration and measurement of very high temperature sources.

References

(1) International comparison of high-temperature standards, *N.B.S. Tech. News Bull.*, **42**, 1958, p. 140.

(2) High temperature measurements, *N.B.S. Tech. News Bull.*, **42**, 1958, p. 125.

INTERNATIONAL TRANSISTOR EXHIBITION

THE use of transistors in instrumentation is now so widespread that it was not surprising to find that many of the examples of the applications of transistors had already been shown at previous exhibitions, in particular at the R.E.C.M.F. However, it is the first time that an exhibition has been devoted solely to transistors and the Transistor Exhibition provided an excellent opportunity for assessing the impact that the development of transistors has had.

A convention on transistors and associated semiconductor devices was held in conjunction with the exhibition. The convention consisted of 23 sessions devoted to the following aspects:

Materials
Basic theory
Characteristics and their measurements and transistors as a circuit element
Applications—
    Communications;
    Use of transistors in computing elements;
    Industrial applications and instrumentation;
    Linear amplification and oscillators;
    High-speed switching and timing circuits.
Technology and design and manufacture.

The papers presented are being published by the I.E.E.

A large proportion of the exhibition was devoted to design and manufacture of transistors and the measurement of their parameters, and to the achievements in the field of miniaturisation. Items of particular interest are described.

Silicon Solar Cells

Three firms were exhibiting silicon solar cells, **Ferranti Ltd., International Rectifier Co. (Great Britain) Ltd.** and **Siemens & Halske A.G.** Silicon solar photo-voltaic cells will convert radiant energy from the sun or from incandescent lamps into electrical energy. The **Ferranti** cells have a response time of a few microseconds and will operate at a maximum junction temperature of 120°C. The cells are available in various shapes and sizes, the maximum area for a single cell being two square inches. Their uses include power supplies for unattended or remote electronic equipment, the detection and measurement of light and the shorter wavelength radiation, and in devices such as photometers, temperature controls, photo-electric eyes and punched paper tape readers. For the punched paper tape readers Ferranti manufacture a miniature multiple cell.

The **International Rectifier Co.** showed ruggedised silicon solar cell modules which have been designed to supply any desired power rating. The modules are assemblies of series connected 1 × 2 cm silicon solar cells and a typical installation can supply a charging current of from 25 mA to greater than 1 amp into a 12 V nickel cadmium battery in bright sunlight.

The **Siemens & Halske** silicon solar cells have an efficiency of approximately 10% and are applicable for operation in recording, metering and switching equipment.

Thermo-electric Generator

This device, developed at the **Semiconductor Institute,** Leningrad, converts the thermal energy of a paraffin lamp into electrical energy for operating d.c. devices such as battery-type radio receivers. It consists of two thermo-electric alloy batteries, one for the filament circuit and the other for the anode and grid circuits of the radio receivers. The batteries are connected to the terminal block fixed on the cooling fins.

Temperature Controller

A transistorised temperature controller shown by **Hatfield Instruments Ltd.** will control the temperature of ovens in instrumentation techniques, particularly where the temperature is required to be held within very close limits. It operates from the standard aircraft supply, 400 cycles, 208 V, and ±15 V d.c. The basis of the design is a bridge network, followed by an amplifier, phase sensitive demodulator, output transistor and a relay which switches the heater elements of an oven. A 400 cycle supply energises the bridge, one arm of which is a temperature sensitive element, located remote from the controller in an oven. Deviation from the desired temperature unbalances the bridge. The resultant signal is amplified and fed to a phase sensitive demodulator which is so arranged that a rise in temperature switches off part or all the oven heater elements, as required. The sensitivity is high and a change of only 0·05% in the temperature element will give positive operation of the relay. Since the bridge arms have a resistance of 780 ohms, the temperature sensitive element is arranged to reach this value at the desired temperature. Printed circuit methods have resulted in dimensions of 2 in. × 4 in. × 5 in.

The **Ferguson Radio Corp. Ltd.** showed a transistorised temperature controller for use in conjunction with either thermistors or resistance sensing elements.

Thermistors are convenient at temperatures up to 100°C and resistance wire or platinum may be used at temperatures up to 1,000°C or more.

The controller is direct coupled throughout, shows relatively little dependence on ambient temperature or supply voltage and is economical in power, weight and volume requirements.

Stability and resolution of control are of a high enough order to permit a direct calibration of temperature against a ten turn helipot.

Overall accuracy is not worse than 0·1% in temperature.

The temperature control unit, Type TTC72, also shown by the Ferguson Radio Corp., was designed to be used in conjunction with an airborne equipment cooling system where more or less ram air is supplied to a condenser unit via a butterfly type valve mechanically coupled to an actuator.

The control unit includes an a.c. Wheatstone bridge, one arm of which is a temperature-sensing element inserted directly in the flow line of the refrigerant. As the temperature of the refrigerant deviates from nominal, the out-of-balance signal from the bridge is amplified and fed to a pair of phase sensitive output stages. A relay, in the collector circuits of each of these output stages, operates when a predetermined value of error signal is present. Operation of one relay allows the actuator to rotate in a clockwise direction, reducing the ram air flow, operation of the other relay causes the actuator to reverse direction, thus increasing the ram air flow.

Static Switching System

This recent development in the field of control engineering was demonstrated by **British Thomson-Houston Co. Ltd.** The static switch system is based on completely static transistorised switching units. The system replaces relays by logic units, particularly those which are subject to frequent operation.

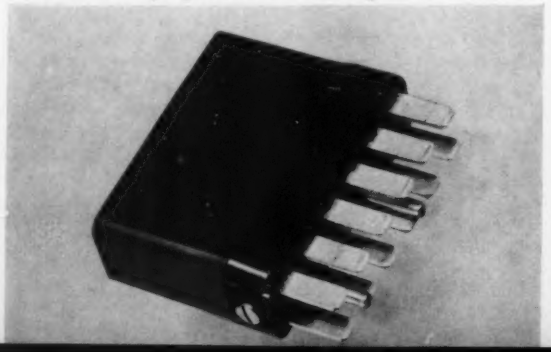
A fundamental difference between relays and static switching units is that relays generally have only one input circuit (the coil) and may have several output circuits (the contacts), whereas the static switching unit can have several inputs but has only one output which can be ON or OFF according to the state of the input(s).

The functions provided by static switching units are based on the principle that the fundamental requirements can be expressed in terms of only two distinct concepts.

(a) That the provision of an input, or inputs, may cause the output of the switching unit to switch either ON or OFF.

(b) That the number of inputs that must be applied to the static switching unit before output switching occurs may be varied according to whether the equivalent of series, parallel or series-parallel arrangement of contacts is required.

Transistorised plug-in static switching unit



The units employ only static components; resistors. non-electrolytic condensers and semiconductor devices, A small neon lamp incorporated beside each logic input socket indicates the ON or OFF state of the unit and simplifies maintenance inspection by enabling a visual check of operation to be made quickly.

D.C. Amplifiers

Transistorised d.c. amplifiers are widely used in many branches of the electronics industry today, and considerable advantages can be obtained from the employment in them of silicon transistors.

When d.c. signals of the order of millivolts or microamps are to be amplified and the range of ambient temperatures is large, drift in the d.c. levels of the amplifier is liable to be significant. This is due to the temperature dependence of certain transistor parameters.

Satisfactory reduction of drift can be achieved with silicon transistors. The following techniques are commonly used:

(i) addition of a compensating temperature-sensitive component

(ii) balancing by means of pairs of transistors in emitter-coupled stages

(iii) chopping of the signal to permit the use of a.c. amplifier techniques.

Frequently the chopper type of circuit is ruled out by its limitations in frequency response and by its complexity.

The Sensistor stabilised amplifier developed by **Texas Instruments Ltd.** makes use of technique (i). The Sensistor has a temperature coefficient of +0·7% per °C and by the addition of shunt and series resistors the change in resistance with temperature can be made to cancel the base to emitter voltage variation when inserted in series with the emitter of the transistor.

A series of eight circuits each demonstrating a different method of using transistors for d.c. amplification was shown by **Mullard Ltd.**

The transistor thermocouple amplifier ND.1221 shown by **Elliott Nucleonics Ltd.** makes use of technique (iii).

A transistor chopper provides an a.c. carrier waveform of amplitude proportional to the d.c. input. Amplification of the a.c. is achieved by use of two "ring of three" amplifiers, each of which employs negative feedback which stabilises the gain as well as providing compensation against changes of operating point with temperature.

The instrument may be used as an amplifier or transmitter of low millivolt signals including thermocouple measurements in which case cold junction compensation is supplied. Zero suppression may be provided and voltage measurements may be made in the range of 10 mV and upwards.

By suitable connections the unit may be made to average the temperature of a number of thermocouples. It is isolated from earth so that earthed thermocouples may be employed. A complete equipment comprises the amplifier unit and transistor power supply each plugged into a single mounting frame which may be fitted with a meter indication of temperature or input level.

Level Measuring Unit

The General Electric Co. Ltd. showed a level measuring unit which can measure the quantity of liquid or free-flowing granular material in a container. It is useful when more normal methods such as float gauging, sight glass, or weighing techniques cannot be used.

A typical application is in aircraft where oxygen is carried in liquid state in vacuum flasks. In this case a float gauging or sight glass technique is impracticable because of the thermal losses that would occur through the coupling to the indicator, and a weighing technique is impracticable because of vibration and changes in the position of the aircraft.

The quantity of liquid in the container is displayed on a meter to an accuracy of $\pm 2\frac{1}{2}\%$ over the temperature range 0 to 35°C. An accuracy of $\pm 5\%$ is obtained over the complete working temperature range of the unit of −40°C to +70°C. A relative humidity up to 100% is permissible. Several meters can be operated from the same unit, if required.

The level measuring unit utilises the difference in dielectric constant between air and the material in the container. A capacitor consisting of an insulated electrode fitted inside the container and the container itself forms part of a capacitance bridge. If the container is not of a conducting material, a second electrode must be fitted. A control is provided to balance the bridge when the container is empty, i.e., set the meter reading to zero, while a second control adjusts the meter reading to full scale when the container is full. The second control is necessary to match the gain of the amplifier to the dielectric constant of the material being measured.

The equipment is fully transistorised, and operates from a 28 V d.c. supply. The level measuring unit consists of an oscillator, a capacitance bridge, and a detecting amplifier. The oscillator generates a 4 kc/s supply to feed the capacitance bridge.

Phototransistor Pickup

A transistor photo-electric pickup designed for use with either a stroboscope or frequency meter for the measurement of rotational speeds was exhibited by **Dawe Instruments Ltd.**

The Type 716 phototransistor pickup used with a frequency meter such as the Dawe Type 715 provides a means of measuring rotational speeds well above 100,000 rev/min without imposing any load upon the machine under test.

The unit can also be used to trigger the Type 1200 Stroboflash or Type 1201 Stroboflood to synchronise it with the machine to be examined. This makes possible the study of rotational or other cyclic motion of varying speed without the need for adjustment of the flashing rate of the stroboscope.

The apparatus consists of a focused-beam lamp and a phototransistor, housed together. It is positioned so that the light is directed on the rotating mechanism marked with contrasting sectors. The varying amount of light reflected from these sectors modulates the current flow through the phototransistor. The output signal is applied to a two-transistor bi-stable circuit, forming a rectangular wave for operation of the Type 715 transistor frequency meter. An inductance in the switching circuit gives a pulse of sufficient amplitude to trigger the Type 1200 Stroboflash or Type 1201 Stroboflood.

Transistor frequency meter

(*Continued from p. 726*)

The panel is automatically fed in against the locating gauges and sprayed with lubricant. The gauges are withdrawn during the downstroke. On the upstroke, the formed panel is automatically lifted and ejected and gripped by the take-off unit. As one panel is removed, the locating gauges are lifted to position the incoming panel. All these automatic operations are initiated by solenoid-operated valves controlled by the Masterotor.

The first advantage found was that the elimination of cam "dwell" experienced with conventional cam-operated switch control enabled every operation to be non-overlapping. The actuation of the various functions in "cascade" form has great advantage in locating any mechanical failures in the handling equipment. The greater accuracy of setting allows the blank to be fed so closely behind the ejected panel that the press can now be run continuously with a resulting increase in output. The clutch remaining in constant engagement reduces wear and maintenance.

It has not been found possible to design varying tools for the automatic operations to take place exactly at the same point in the crankshaft cycle, due to varying depths of draw, etc. It is necessary, therefore, when changing tools to reset the timing of the handling equipment.

Considerable time is saved on setting with the Masterotor. The plugs are moved to pre-arranged positions or alternatively the particular tool card is hung in front of the socket panel and the plug inserted through pre-punched holes in the card to give accurate settings. Individual idiosyncrasies due to tool setting and press conditions can be taken care of by the setter by advancing or retarding the plugs at will.

Fig. 1. *Complete queueing-time indicator equipment showing, from left to right, the store, the clock and the observer's desk*

QUEUEING-TIME INDICATOR FOR U

Introduction

MEASUREMENTS of journey-times along sections of a route and queueing-times at intersections on the route are made regularly by the Road Research Laboratory in various surveys of town traffic. A test-vehicle manned by observers is injected into the traffic stream and its journey-times and queueing-times are measured in each section of the route. The average values of these times for a number of journeys are then calculated.

Apparatus has been devised which greatly assists the observers in their task, and also shortens the analysis time. It is essentially an electric device designed to indicate the total inclusive time occupied by a cluster of short periods where the last period is not known to be the last at the time. Such is the case with queueing-time, which is measured from the beginning of the first stopped period (caused by the traffic signals at the next intersection) to the end of the last stopped period before the vehicle leaves the intersection. Queueing-time thus includes time spent moving in the queue between stops. The intermediate time between stops is therefore included in the measurements but the time from the last start until the vehicle crosses the intersection is excluded. The last stopped period is not known to be the last at the time. The development and design of the indicator to meet these requirements is described in detail in this article.

The equipment is shown in Fig. 1. The observer is provided with a small desk on which the journey log-sheets are held; push-buttons are pressed at each stop and start of the vehicle while queueing, and a change-over switch is operated as each new section of the route is entered. The required queueing-times and journey-times, which are indicated by electric digital registers set in the desk, are copied directly on to the log-sheets and the registers are then reset to zero.

Principles of Measurement

Time intervals are measured by counting the number of electrical impulses received from a half-second contactor clock during the period to be measured.

Function of Queueing-time Circuits

The basic functions of this circuit are shown in block diagram form in Fig. 2. From the commencement of the first stopped-period, pulses from the clock are fed straight through the store into the (initially empty) register. When the vehicle starts again at the end of this period, the outlet T is closed so that the number shown on the register represents the period that the vehicle was stopped: subsequent pulses from the clock are retained in the store in case they are needed, as it is not known whether a further stopped-period may occur until the vehicle has actually passed the traffic signals at the intersection. If the vehicle stops again before leaving the intersection, the outlet T is re-opened allowing the accumulated pulses (which now represent the intermediate period between the stopped-periods) together with further time-pulses from the clock to be recorded on the register; if the vehicle does not stop again before leaving the intersection, the amount in the

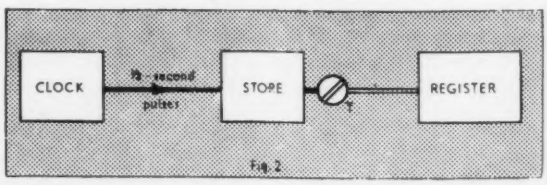


Fig. 2

The instrument described is used to indicate the inclusive time occupied by a cluster of short periods, where the last period is not known to be the last at the time.

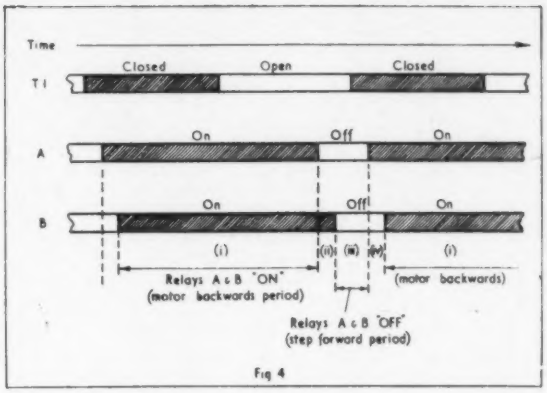


Fig 4

A MOVING VEHICLE

By P. B. ELLSON, A.M.I.M.I.*

store is not required and must be discarded before the store can be used at the next intersection.

Store

In practice, the store consists of a both-ways uniselector. This uniselector has two separate magnet coils which are arranged so that the rotor may be driven in either direction at will. The uniselector operates on the leading edges of pulses, i.e., it is a forward-acting type. Pulses from the clock contacts (T1) are taken to one of its magnet coils (M1) and thus step the uniselector forward one position for each pulse received (Fig. 9). The uniselector may be "emptied" by using the other magnet coil (M2) to motor the rotor back again to its zero position. In doing so, the interrupter contacts (dm2) will operate rapidly a number of times, this number being equal to the number of pulses originally applied to the forward-stepping magnet coil. The pulses generated by the interrupter contacts can be used to operate the register. The pulses from the clock will be counted on the uniselector if the motoring circuit is not energised, but will be passed to the register by the interrupter contacts if the motoring circuit is energised (i.e., each forward step of the rotor due to a pulse from the clock will be followed by a backward step due to the energised motoring circuit; at each backward step one pulse is generated by the interrupter springs and fed to the register).

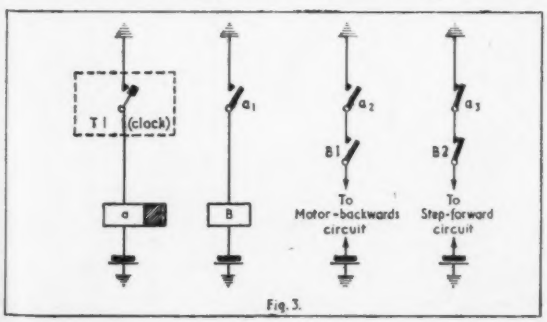


Fig. 3.

If a large number of pulses has been accumulated in the uniselector and the motoring circuit is then completed, the backward motion of the rotor may last longer than a half-second and arrangements must be made for the motoring to be momentarily stopped when a pulse is expected from the clock, so that it may step the rotor forward by one place; after this, backward motoring may continue at a rapid rate.

Pulse Length

It follows directly from the above that the clock pulse itself should be short in order to give long intervals between the pulses; this will allow the uniselector the maximum time for backward motoring.

The contacts in the clock are open approximately $\frac{1}{4}$ second and closed approximately $\frac{1}{4}$ second.

Figure 3 shows how a relay *a* may be operated by the clock contacts (T1), and another relay B from contacts a_1 on *a*.

If A be a suitable slow-release relay, the period when both A and B are "on" can be lengthened and the period when they are both "off" can be reduced to a short pulse (see Fig. 4). This cycle will be repeated every half-second. It will be noted that periods (ii) and (iv)serve to isolate the two operative periods(i) and (iii).

* Road Research Laboratory, Department of Scientific and Industrial Research.

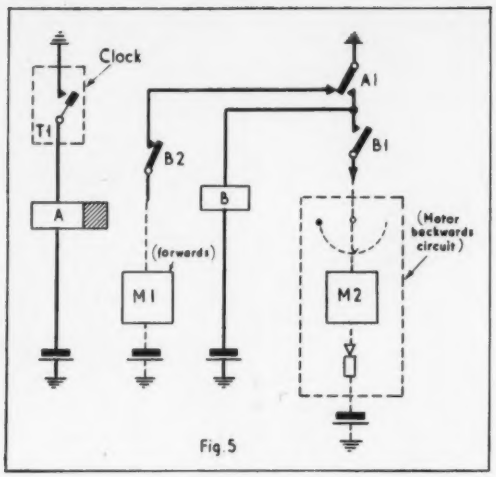


Fig. 5

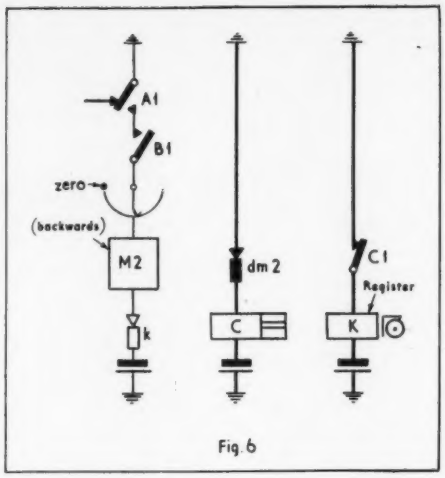


Fig. 6

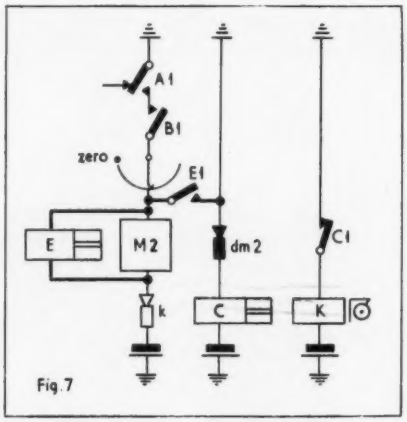


Fig. 7

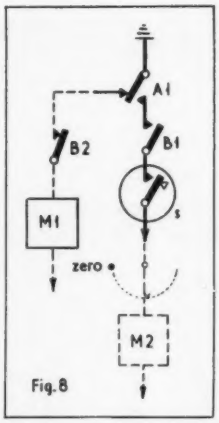


Fig. 8

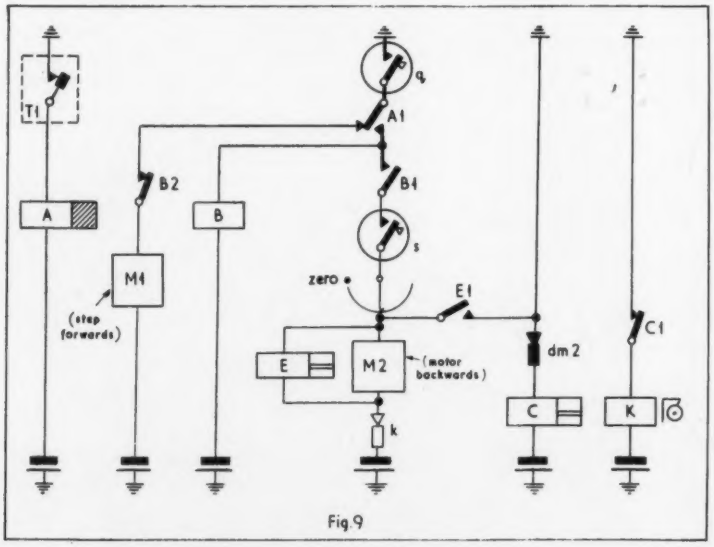


Fig. 9

The circuit of Fig. 3 may be replaced in practice by that shown in Fig. 5, where the contacts A1 are substituted for the three sets of contacts a_1, a_2 and a_3

The uniselector "step-forward" circuit consists simply of the "forwards" magnet on the uniselector, shown as M1. The "backwards" magnet M2 and the usual homing arcs and interrupter contacts on the uniselector form the motoring circuit.

Store to Counter Linkage

It has already been stated that every break of the interrupter contacts is recorded on the register, and to ensure that the register cannot miss any of these rapid pulses the two units are interlocked as shown in Fig. 6. Thus, when A1 and B1 are closed (in motoring periods) the "backwards" magnet M2 is energised via contacts k which are normally closed (contacts k are break contacts on register K): the interrupter contacts dm2 open, releasing relay C: contacts C1 close the circuit through register K: contacts k open, breaking the circuit through M2 and when interrupter dm2 closes, relay C is energised; contacts C1 break the circuit through register K, and when k closes a count of one has been recorded on the register. This cycle repeats rapidly until either the zero position on the uniselector is reached or the motoring period is ended by contacts A1 opening.

In the latter case, if the supply should be cut off by A1 during one of the above cycles, a pulse may be missed, and precautions must be taken to prevent this. Once M2 has been energised, the cycle must be allowed to continue until k opens before cutting off the supply. M2 must have a self-locking circuit which will maintain the supply to itself once established, and until k opens. This is provided by the relay E shown in Fig. 7. E is a high-speed relay which closes immediately M2 is energised and which locks up through its own contact E1 and k. It therefore remains closed until k opens. If A1 should open during this period, the supply to M2 is retained through E1 until the cycle is completed by the opening of k: if A1 has not opened by the time k closes again, the cycle will repeat if the zero position on the uniselector has not been reached.

Method of Control

If a manual on/off switch *s* be included in the motoring circuit, as shown in Fig. 8, then when this is open short pulses will be fed to the forward magnet coil M1 every half-second, causing the uniselector to step forward one position for every pulse received. Nothing is recorded on the register K because interrupter contacts dm2 remain closed. If the switch *s* is then closed, the motoring circuit will be energised in between each pulse, and the uniselector will motor backwards rapidly in these intervals until empty; in so doing it will record the number of steps on the register K.

If another manual switch *q* is inserted in the B relay circuit, as shown in Fig. 9, the equipment might be used as follows. At the first stop of the test vehicle, close *q* and *s*. A pulse would be fed to the forward magnet coil M1 causing the rotor to advance one step every half-second; in the intervals between pulses (the motoring circuit being "on" at *s*), the rotor would be stepped backwards that one step (to zero) with the consequent addition of a count of 1 on the register K. When the test vehicle restarts, switch *s* must be opened; the uniselector rotor continues to step forward every half-second but is not stepped backwards in the intervals, so that the register K does not record any further pulses but shows the number received while the vehicle was stationary. If the vehicle stops again, switch *s* must be closed; the motoring circuit will then empty the uniselector and transfer the number stored therein to the register while at the same time adding the incoming pulses to the register as they arrive. (About 8 backward steps take place between each interruption.) When the vehicle restarts, *s* is opened and the register now shows the total of the two stationary times and the intermediate time. This process may be repeated until the vehicle leaves the intersection, when the switch *q* should be opened so as to stop the advance of the uniselector rotor. It then remains to arrange to reset the register and uniselector to zero. The amount stored in the uniselector is not required.

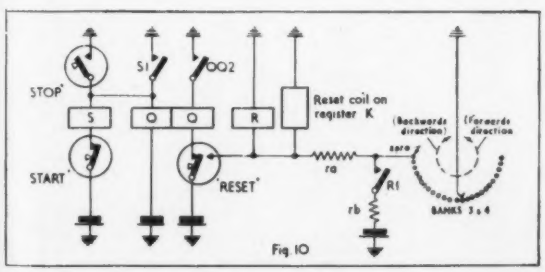


Fig 10

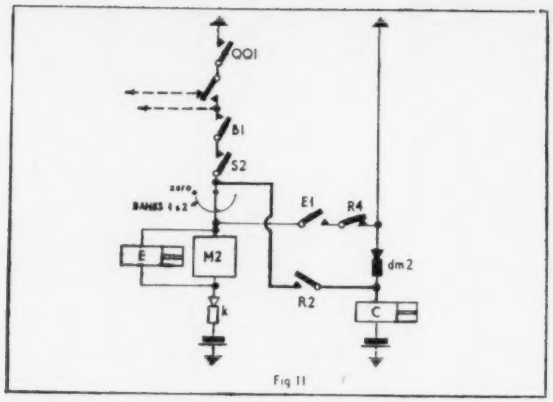
Push Buttons

To avoid the above somewhat confusing sequence of switching and to provide a simple reset arrangement, push-button control was introduced, with a red button for vehicle stopping (Stop), a green one for vehicle starting (Start) and an amber one for resetting the register and uniselector (Reset). Figure 10 shows the circuit used for push-button control. The buttons are based on microswitches of the changeover type. When Stop is pressed, relays S and QQ lock on through contacts S1, and QQ is also locked independently by contacts QQ2. When Start is pressed, relay S is unlocked but relay QQ remains locked by contacts QQ2. When Reset is pressed, relay QQ is unlocked and relay R is locked on through contact R1; also the register reset magnet is energised making the register read zero. Other contacts on relay R cause the uniselector to home to zero, and when this has occurred, relay R is short-circuited by the rotor arm (banks 3 and 4) in the zero position so that R drops off. Resistors *ra* and *rb* serve to limit the current during this action.

The manual switch *s* of Figs. 8 and 9 can now be replaced by the contacts S2, arranged to be closed when relay S is "on". The manual switch *q* of Fig. 9 can be replaced by contacts QQ1 which are closed when relay QQ is "on". These are shown in Fig. 11.

High-speed Homing

The uniselector can be homed at high speed if the link with the register K can be temporarily overridden.



This was accomplished by the addition of the contacts R2 (see Fig. 11). When relay R is "on", contacts R2 close the homing circuit via the interrupter dm2, R2, banks 1 and 2, M2 and k. Contacts k are held closed during this action by the energised register reset magnet. Contacts R4 (normally closed) are required to open the E1 circuit during homing to prevent the magnet coil M2 from locking up. When the uniselector reaches the home position, relay R and the register reset magnet are both released, the latter unlocking the contacts k in the process.

Storage Capacity

The both-ways uniselector was only available as a 4-level 25-position unit. By removing alternate arms from the rotor, it was converted to a 2-pole, 50-position unit. The maximum capacity of such a unit alone would be 49 half-seconds, but as intermediate times of up to $1\frac{1}{2}$ minutes were considered possible, three relays X, Y and Z were used to extend the capacity as shown in Fig. 12.

Resetting

To reduce the resetting time of the uniselector to a minimum, contacts R3 (normally closed) on the resetting relay R are arranged to unlock any of the three storage relays X, Y or Z as may be locked on at the instant of resetting (see Fig. 12). This ensures that the uniselector reaches home in less than one revolution; without it, the stored count might require nearly four revolutions to clear.

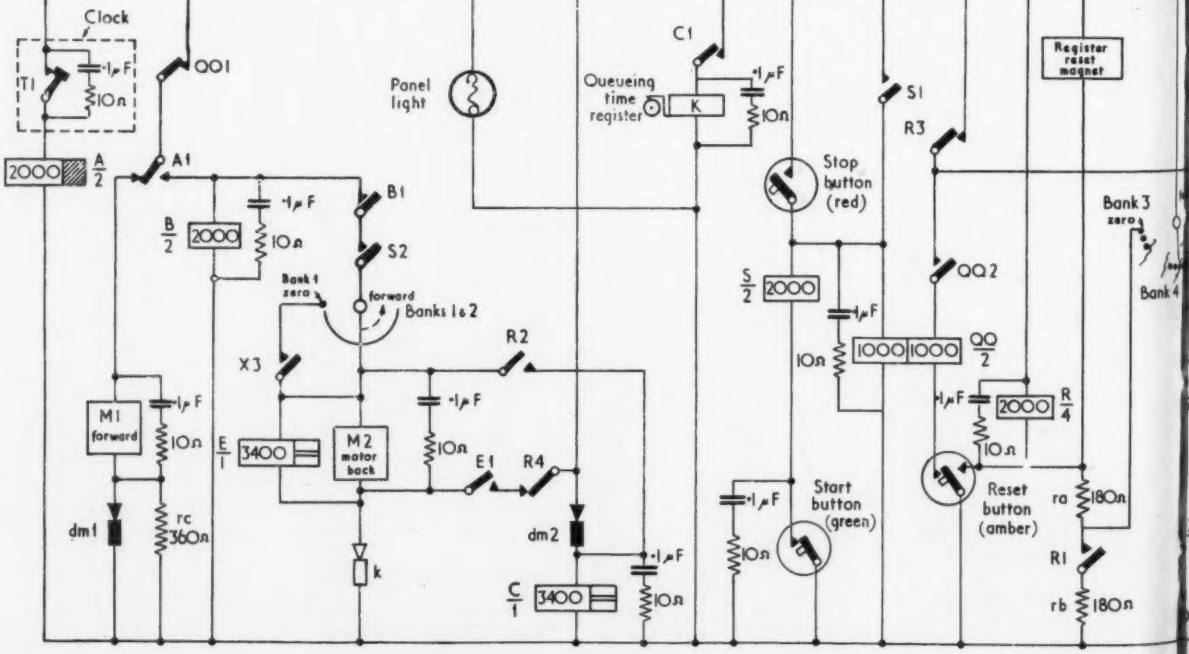
A useful saving in current can be achieved by the use of the interrupter springs dm1 (associated with the forward magnet coil M1) bridged with a suitable resistor and wired in series with the coil (see Fig. 12).

Spark quenching circuits consisting of 0·1 microfarad capacitors with 10 ohm series resistors were fitted throughout.

Journey-time Circuits

A simple addition to the circuit enabled journey times to be measured. A pair of normally closed contacts A2 on the slugged relay A produce short pulses each half-second which can be used for actuating registers as shown in Fig. 12. The registers can be seen set in the top centre of the observer's desk in Fig. 1.

Fig. 12



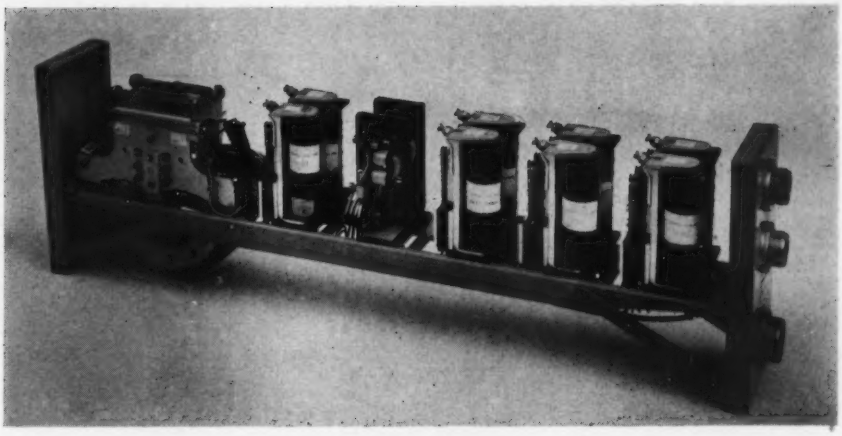
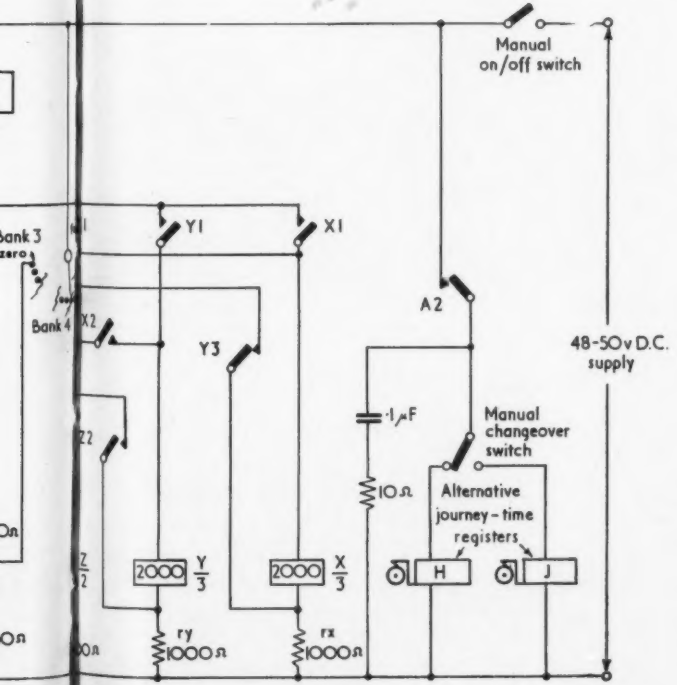


Fig. 13.
The storage unit with cover removed

Power Supplies

The equipment described was designed for operation from a 48 volt supply, but other voltages could be used if the component values were suitably modified. Although peak current was in the neighbourhood of 1 A, the mean current is considerably lower and the equipment has been worked satisfactorily from two dry h.t. batteries (Drydex H 1013) in parallel, or from a transistor d.c. converter.

The ten relays and the uniselector were mounted on a modified P.O. relay rack No. 14/BH, as shown in Fig. 13, and housed in a wooden box approximately 3½ in. × 7 in. × 18 in. which is shown together with the clock (T1) and observer's desk in Fig. 1.



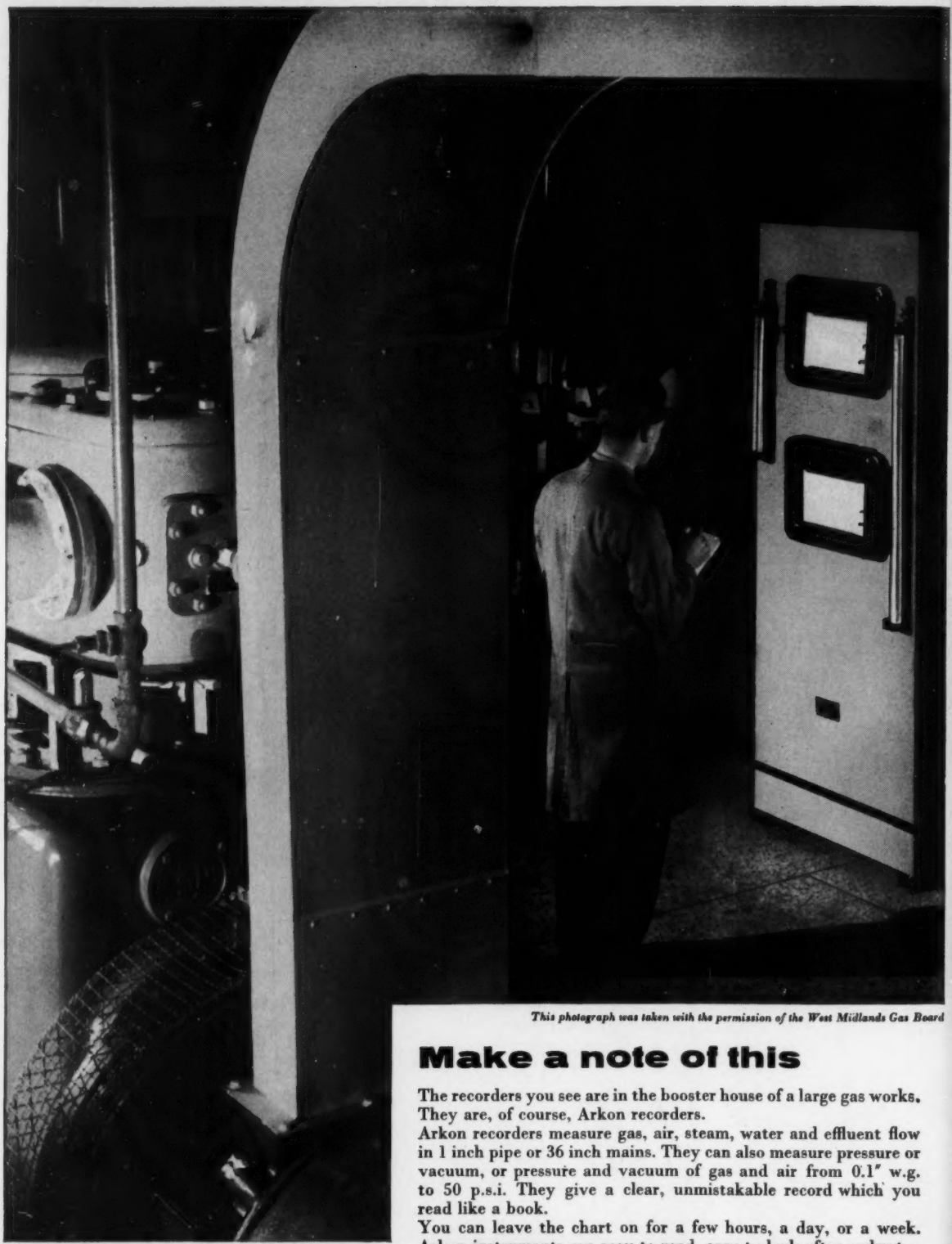
Acknowledgement

The instrument described in this paper was developed as part of the programme of the Road Research Board of the Department of Scientific and Industrial Research. The paper is published by permission of the Director of Road Research.

Key to Figure 12

M1	G.E.C. B/W selector— "forward" magnet coil, 120Ω
M2	G.E.C. B/W selector— "backward" magnet coil, 120Ω
dm1	Interrupter springs operated by M1
dm2	Interrupter springs operated by M2
K	Sodeco counter, 700Ω ; reset 330Ω, 48 V
T1	Contacts of clock, 2 c/s
A/2	P.O. 3000-type relay, ½ in. heel-slug, 1B, 1 C/O
B/2	P.O. 3000-type relay, 1M, 1B
C/1	Siemens high-speed relay, 1B
E/1	Siemens high-speed relay, 1M
QQ/2	P.O. 3000-type relay, double wound, 2M
R/4	P.O. 3000-type relay, 2M, 2B
S/2	P.O. 3000-type relay, 2M
X/3	P.O. 3000-type relay, 3M
Y/3	P.O. 3000-type relay, 2M, 1B
Z/2	P.O. 3000-type relay, 1M, 1B
H, J	Sodeco counters, 60Ω, 12 V
k	Contacts operated by K, 1B

All resistors are 5 watt, wirewound.



This photograph was taken with the permission of the West Midlands Gas Board

The keen eye will be able to pick out in this photograph an Arkon Liquid Flow Indicator on the pipeline above, and Arkon Full Scale Pressure Gauges on the panel itself.

Make a note of this

The recorders you see are in the booster house of a large gas works. They are, of course, Arkon recorders.

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Plug-in Precision Limit Switch with Micro Adjustment

DESIGNATED Class 9007, Type AW-36, this switch has roller plunger actuation with fine adjustment of the roller initial position over a full $\frac{1}{8}$ in. range. Roller position is adjusted by turning a knurled knob. Locking screw in centre of knob clamps roller in desired position.

Roller direction can be changed 90°. Normal roller operating direction is parallel to the bottom of the box. The roller plunger can easily be rotated 90°, without the use of tools, so that the roller operating direction is perpendicular to the bottom of the box.

The switches contain a precision snap switch mechanism designed to withstand the vigorous operating conditions associated with machine tool control. Contacts are single pole, double throw with isolated normally open and normally closed circuits.

The enclosure of the switch consists of a die-cast box with a conduit entrance at one end and drilled so that it may be mounted on either side of the back. The snap switch, roller plunger and overtravel mechanism are attached to the cover which is symmetrical with the box giving a total of six different mounting arrangements with one device. Construction is industrial oiltight and is specially suited for mounting on machine tools in the presence of cutting oils.

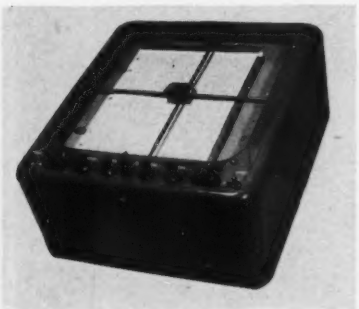
A similar switch but without plug-in feature, designated Type AW-32, is also available.

Circle **1** *for further details.*

Houston HR-92 X-Y Recorder

THE HR-92 X-Y recorder is a null-balance servo-type plotter designed to draw curves in Cartesian co-ordineats with an accuracy of better than 0·75%. The flat-bed bench mounting construction utilises 8½ in. × 11 in. graph paper with full chart visibility. The clip-on pen is of "straight-through" design, with no bent capillaries, to facilitate cleaning, filling and rapid interchange for multicolour traces. The X and Y axes are electrically and mechanically independent; each employs a chopper-type amplifier with separate power supply, a two-phase servo-motor and a 3-turn rebalance potentiometer energised by a mercury reference cell. The response is critically damped, with a pen speed of 7·5 inches per second and sensitivity of 10 millivolts per inch (alternatively 1 mV/in.). The input resistance is 10,000 ohms but can be adjusted by removing an internal link to give infinite impedance at balance. The simplified control panel has duplicate zero setting and continuously-variable attenuator adjustments, separate standby and power switches, and a "load-operate" control which removes the pen carriage to facilitate rapid chart loading. Gain and calibration adjustments can be made by screwdriver controls readily accessible beneath the front panel. The plug-in unit construction of the amplifiers makes removal easy if servicing ever becomes necessary. The overall dimensions of the recorder are 14 in. × 15½ in. × 8 in. and the weight is 35 lb. Typical applications are the rapid plotting of transistor and valve characteristics, hysteresis or filter curves, computer readout, torque/speed, temperature/pressure, stress/strain, and other low frequency phenomena including bio-medical data.

Circle **2** *for further details.*



Houston HR-92 X-Y recorder

Transistor Tester

THE transistor beta tester introduced by Siemens Edison Swan Ltd. is selling at a price of £11 0s. 0d. with special terms to trade and industry.

Its purpose is to provide quick and accurate tests on all p-n-p transistors, current gain and collector leakage being measured under common emitter conditions.

Current gain (10-150) is read directly off a calibrated dial in conjunction with an audible signal at a collector current of 0·5 to 4 mA. Leakage current is measured on a meter at a fixed collector voltage of 9 volts. Accuracy is 5%.

The beta tester is a battery-operated transistorised unit in a die-cast alloy case. The terminals are of the quick release type.

Measurements can be carried out by unskilled personnel in a few seconds. Full operating instructions are printed on the back cover of the tester.

Circle **3** *for further details.*

Coil Bonding Timer

WHEN using self-bonding wires which are now available, the quickest method of effecting the bonding of a coil is to pass through it, for a short period, a current of suitable magnitude. Since the voltage required to do this may be quite high, it is first necessary to check the insulation between the wire and the mandrel on which the coil has been wound.

The Avo Bonding Timer can carry out both these functions in the following manner :

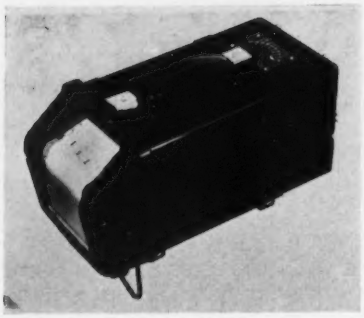
The two ends of the coil are attached to terminals on the device, and switches operated simultaneously by both hands to give direct reading in MΩ of the value of the insulation between the coil and the mandrel. If the insulation value is satisfactory, the operation of a third switch allows the heating current to pass through the coil for a pre-determined period.

Because the operator's hands must both be employed whilst these tests are made, the apparatus is intrinsically safe. Timing of the bonding current is variable between ¾ sec—2½ min., whilst insulation can be measured up to 500 MΩ.

The instrument operates from 210-250 volts, 50 c/s mains, but where the mains voltage is considered too high for bonding purposes, a lower voltage for bonding can be injected via terminals provided.

Circle **4** *for further details.*

Coil bonding timer



Portable recording instrument

Portable Recording Instrument

A PORTABLE multi-range graphic ammeter/voltmeter is now available on which it is possible to record current values in six ranges and voltages in two ranges, selection of the range being made by means of a built-in rotary selector switch. Operating in conjunction with a Smith/Hobson "Clam" type split-core current transformer on the current records, ranges of 10, 25, 50, 100, 150, 250 and 500 amperes are available, while when direct-connected to the system, the voltage ranges are 250 and 500 volts. Separate terminals are provided on the instrument for current and voltage measurements. The grapher is of the moving-coil rectifier type for use on a.c. systems and has a capsule, non-spillable, inking system giving a record on a 4 in. chart.

Circle **5** *for further details.*

DCL 'M' Metering Pumps

THE DCL 'M' range of metering pumps has been adapted for automatic control. Developed primarily for the accurate metering of small quantities of fluids, the new range can now be operated with pH, temperature, flow and other controls.

These automatically-controlled DCL 'M' pumps are responsive to pneumatic signals of from 3 to 15 p.s.i., adjustment of the plunger stroke being carried out by a small, compact bellows motor operating through a mechanism designed to reduce "hunting". Available with different plunger sizes giving a range of capacities from 0-750 cm³/hour to 0-37·3 litres/hour, the pumps are suitable for working pressures up to a maximum of 2,400 p.s.i., the maximum pressure depending upon capacity. The output from each pump is proportional to the air pressure, the control gear being designed to give maximum capacity at either 3 or 15 p.s.i.

Pump heads are interchangeable, the head in each case being easily removed and replaced by one of different capacity. Power is provided by a 1/15 h.p. totally enclosed induction motor. The suction and delivery valves, both of which are duplicated, are of 12% chromium non-corrodible steel balls specially lapped to ensure high volumetric efficiency. Valve bodies, seats and the valves themselves can be readily removed by merely slackening one set screw, to facilitate inspection and maintenance.

As with other types of DCL 'M' pumps, hydraulically operated diaphragm heads are available for applications where it is desirable to avoid having glands in contact with the liquid being pumped. This is especially useful in cases where noxious fluids are being handled or when sterile conditions are required.

The present price of the standard 'M' plunger pump is £95 ex works, the 'M' pump with stainless diaphragm head being £130. When fitted with the bellows unit for automatic control, the prices are £145 and £180 respectively, normal delivery being ex stock.

Circle **6** *for further details.*

Instrument Rack

THIS rack, known as the Imrak, International Series, can carry equipment fitted with British, American and Continental fixings at one and the same time. It packs flat for ease of storage, ease of transport, ease of export. It can easily be adapted for sealing, ventilation, moving or baying-up.

The rack will be available in a range of heights and in two depths for each of the two standard G.P.O. panel widths.

Circle **7** *for further details.*

Stabilised Power Supply Unit Type L.101

THE stabilised power supply Type L.101 is a special purpose instrument which provides a constant voltage source of 600 volts positive and two stabilised negative 150 volts d.c. supplies, one of which is a variable line having a high impedance source.

Two stabilised 6·3 volts a.c. supplies are provided which enable valve heaters to be fed with a constant voltage to maintain valve characteristics stable and eliminate errors due to filament supply variations resulting from fluctuating mains supply.

A stabilised variable 0-150 volts negative line of high source impedance is provided as a grid bias supply or for use in circuits drawing a small current load of not more than 5 mA. A 100 to 800 volts unstabilised line is also provided for general use.

Voltage variation on the positive 600 volts and negative 150 volts lines is better than 0·03% of output for a 10% change of input voltage, and the variation in output from the two 6·3 volts a.c. lines is less than 0·02 volt for the same condition.

The output impedance is less than 0·1 ohm at d.c. and less than 0·5 ohm at 50 kc/s on all d.c. lines. The variable negative 0-150 volts d.c. line has a source impedance of 12,000 ohms. Ripple content is less than 3 mV r.m.s. on all stabilised outputs at 150 volts and below. Above 150 volts the ripple content is less than 0·002% r.m.s. and on the unstabilised 100-800 volts d.c. it is about 3 volts r.m.s. at 800 volts with 300 mA load.

Other facilities include control of the h.t. stabilised d.c. line enabling the output to be set to any desired level from 0-600 volts together with a source resistance control over the range 0 to 40 ohms. Hum can be superimposed on the stabilised d.c. h.t. line and may be varied between 0 and 6 volts r.m.s. to give a good quality sine wave at the mains input frequency.

All outputs are floating with respect to the chassis, the positive and negative lines being connected through the neutral terminal.

Circle **8** *for further details.*

Transistor Holders

As transistors begin to replace valves, the demand arises for a transistor mounting.

A range of transistor mountings, moulded in Helvin p.v.c., is now being manufactured. These easily and effectively clip transistors to printed circuit boards or the conventional chassis; the bollard in the base of the moulding is pushed through a small hole in the panel, and the transistor is held firmly in place.

The holder has the additional advantage of insulating the metal can of the transistor.

There are four sizes to fit different panel thicknesses (this dimension is included in brackets in the part number) : HV.4518 ($\frac{1}{32}$ in.), HV.4518 ($\frac{1}{16}$ in.), HV.4518 ($\frac{3}{32}$ in.) and HV.4518 ($\frac{1}{8}$ in.).

Circle **9** *for further details.*

Sigrist Photometers

SIGRIST photometers are divided into two main categories, for industrial and laboratory use.

All types employ a design feature which enables continuous measurements of turbidity and colour to be carried out quite independently of the usual sources of error found in conventional photometers, i.e., variations in photo-cell sensitivity, light source intensity and amplifier gain.

One type of Sigrist industrial photometer uses flow cells for turbidity and/or colour measurements having a wide variety of finishes for corrosive liquids and gases. Other types enable turbidity measurements to be made from the surface of a liquid and colour measurements from a free-flowing jet.

Weather-proof cases make operation possible under the most arduous conditions.

The Sigrist laboratory photometer makes turbidity and colour measurements possible from static measuring vessels and, due to its independence of instrumental variations, many samples may be continuously compared with a standard over long periods, without adjustments.

The laboratory photometer may be fitted with a built-in monochromator and recorder if desired.

Circle **10** *for further details.*

Sigrist photometer

High Stability Transistorised Power Units

A COMPREHENSIVE range of high-stability transistorised power supplies, including heavy duty models, has been designed as sub-assemblies for inclusion in prototype, research and production equipment. Bench models in a case and including meters are also available, and an overload cut-out system can be incorporated in all models.

The reference voltages are obtained by means of a double silicon Zener diode system, and the complete control circuit is constructed on a single printed panel which is readily accessible and removable.

High stability resistors are employed throughout, and the power transistors are generously rated against overload.

The units can be supplied with zero output impedance if required.

The power units are available with current ratings from 1-10 amp at voltages from 0-30 V, with a stability of $\pm$ 0·1% for models up to 2 A, and better than $\pm$ 0·2% for 10 A models.

The size of a 1 A unit is 8¾ in. × 4¾ in., height 5⅛ in.

Circle **11** *for further details.*

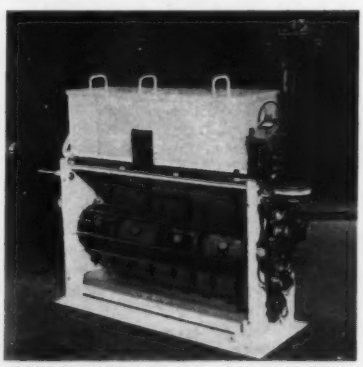
Stonwata A300 Deioniser

THE multi-bed unit will produce approximately 300 gallons of "distilled" water (water with an electrical conductivity of 20 or below; specific resistance 5×10^4 ohm/cm.), at a rate of up to 40 gallons per hour, from a supply containing total dissolved solids equivalent to 230 p.p.m. when expressed in the form of calcium carbonate. On water of lower solids content yields up to 2,000 gallons can be obtained before regeneration is necessary. Regeneration procedure is simple and carried out in situ.

Alternatively, by feeding the "distilled" water into the cartridge, conductivity water of electrical conductivity down to 0·1 (specific resistance 10^7 ohm/cm) can be obtained, at a rate of up to 30 gallons per hour. The "Loughborough" cartridge built into the apparatus has a life of up to 1,000 gallons before regeneration is necessary.

The A300 deioniser is compact, easy to install, operate and maintain, and very economical to run. The only services required are a 240 V a.c. 5 amp point, mains water supply and a waste pipe.

Water for treatment is fed into the apparatus at a maximum inlet pressure of 20 p.s.i.; a pressure gauge is fitted. A pressure reducing valve is recommended. A safety valve is built into the unit as a precaution and is set to blow off at 25 p.s.i. The unit will not operate satisfactorily at pressures below 10 p.s.i. The water then passes through an inlet filter into the multi-bed unit—four Perspex cells filled alternately with cation, anion, cation and anion ion-exchange resins (see illustration). At each end of a resin cell micro-porous plastic filter discs are fitted and small spaces are left between the cells. The water flowing horizontally under pressure can pass freely through the filter discs and so through the alternate cation and anion resin beds. The deionised water from the multi-bed unit, which is now of "distilled" quality, can either be drawn off or fed into the "Loughborough" cartridge for conversion into "conductivity" quality.



Stonwata A300 deioniser

A conductivity meter and two conductivity cells are fitted so that the water-quality can be monitored both at the "distilled" and at the "conductivity" stage.

An instruction booklet giving details of setting-up procedure and of the regeneration process for the multi-bed unit is issued with the apparatus.

Circle **12** *for further details.*

Capacitors for use at Temperatures up to 250°C

A NEW range of silvered mica capacitors has been developed for defence applications.

The new capacitors are designed for use over the temperature range of −70°C to +250°C and are protected by a dip coating of special silicone rubber. Fired construction is employed, the individual silvered mica plates being bonded into a solid block.

Two standard sizes are manufactured and any capacitance value in the range 5 to 50,000 μμF can be supplied to a minimum tolerance of $\pm$½% or 1 μμF, whichever is the greater. Each size is available rated at 200 or 350 V peak for temperatures up to 100°C. These ratings are reduced to 100 and 200 V peak at 250°C.

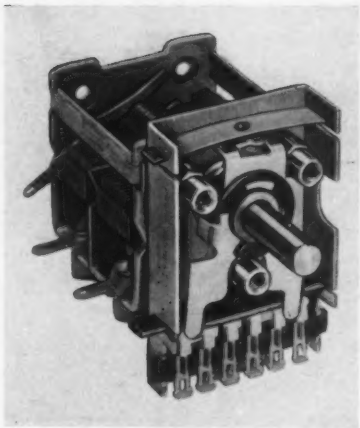
Circle **13** *for further details.*

One-knob Wave Change and Tuning Capacitor

THE introduction of switched variable capacitors enabling normal wave change and tuning operations on any two wave-band radio receiver to be carried out with only one control knob is announced by The Plessey Company Limited.

The new capacitors incorporate a conventional moving vane spindle fitted with a link motion that moves a slide switch in one direction when almost fully meshed, and in the other direction when almost fully unmeshed. It is recommended that the switching is so arranged that the small loss of usable swing occurs at the high frequency end of the long wave-band and the low frequency end of the medium wave-band. By this means, any loss of station coverage is unimportant.

The switch is a two pole change-over assembly but provision has been made, by the addition of a third pole, for dial lamp switching or similar operations; provision can also be made for mechanical wave-band indication.



One-knob wave change and tuning capacitor

Circle **14** *for further details.*

Relay for High Speed Valve Operation

A BOOSTER relay, Model 61H, has been introduced which, it is stated, will improve design of process control loops by making it possible to increase valve stroking speeds considerably without loss of stability.

The relay will give a 10·3 ft³/min average flow for 3-15 p.s.i. change and 13·5 ft³/min for a 15-3 p.s.i. change. When used with Sunvic's own valve positioner, 0·7% of full valve stroke causes 12 p.s.i. valve pressure change. The relay can be used without a valve positioner when speed, but not positioning accuracy, is essential.

The model 61H will accept input pressure up to 100 p.s.i. so that far higher valve stroking speeds than those quoted above are possible. It will work in ambient temperatures from −40°F to +180°F. Dead spot is within 0·05% of full scale; linearity within 0·4% of full scale and reproducibility, when used with Sunvic valve positioner and with 4% valve friction, is within 0·1% of full scale.

Maximum air consumption under balanced conditions is 0·5 ft³/min.

Circle **15** *for further details.*

Sirius, Transistorised Desk-size Digital Computer

SIRIUS is believed to be the smallest and most economically priced computer yet made in Europe. It weighs only 5 cwt., measures approximately 7 ft × 3 ft 6 in. × 4 ft high, including a standard office desk, and can be powered by plugging into ordinary power sockets in any office or laboratory.

It will cost £15,000 and the first production models will be available this autumn. The manufacturing schedule will enable delivery to be made within three months of ordering. The computer is constructed of neuron packages, magnetostriction delay lines and is fully transistorised. It works in decimals, each decimal digit being represented by

Sirius transistorised digital computer

four binary digits. Checking is done inside the machine by automatic detection of forbidden combinations. Input and output is on paper tape and a set of 100 buttons, similar to a desk calculator, may be used to operate the machine or put information directly into the main store. Very few buttons need be used for developed programmes. The basic input/output speeds are the same as for the Company's larger all-purpose Pegasus.

The Company's London Computer Centre has installed the first Sirius and it will be offered for hire at about £15 an hour.

Circle **16** *for further details.*

Electromechanical Torque Motors

THESE torque motors provide a mechanical energy output proportional to an electrical input signal; they have been designed specifically to operate control valves in hydraulic and pneumatic servo actuators, but are suitable for recording instruments and many other duties.

Provision is made for differential or series excitation; differential excitation is recommended as it eliminates datum shift due to supply variations. A torque, which is proportional to the input current, is developed at the output shaft and this, in conjunction with the stiffness of the system, produces a proportional shaft deflection.

The torque motors are available having various values of internal stiffness and when optimum torque arm radius is selected a wide range of requirements can be met.

The ratio of internal stiffness to inertia is high, resulting in a natural frequency of the order of 500 c/s when unloaded. The upper limit for level frequency response can however occur at a lower frequency dependent on the driving source characteristics.

Hysteresis of the torque motors is normally 2% or less of output amplitude and its effect is usually negligible in comparison with load friction. Special models are available with hysteresis less than 0·7% but having a somewhat lower sensitivity.

The torque motor consists essentially of two soft-iron or Radiometal stator units, each with a pair of windings, the cores being separated by two permanent magnets. These items surround a soft-iron armature, the shaft of which is supported at each end by a small ball race housed in an end plate. The end plates also provide mounting surfaces for the purpose of installation.

The windings around the soft-iron cores are connected in such a manner that, when energised, magnetomotive forces set up fluxes which aid or oppose the fluxes derived from the two permanent magnets, causing the armature to rotate from its central position of equilibrium. The direction and angle of rotation are dependent upon the sign and magnitude of the current passing through the windings.

Circle **17** *for further details.*

Additions to Recorders

SINGLE trace and 2, 4, 8 or 16 point multitrace instruments are now available with standard facilities consisting of any one of 13 different input units and a choice of three different chart drive gear boxes. Additional facilities include alarm and control contacts, solenoid pens, retransmitting slidewire, a digitiser so that the recorder output can be shown on an "in-line" display or used to operate a printer, and fast/slow speed recording timer. An integrating system for use with single trace instruments is being developed.

The input units include four millivolt pattern with "plug-in" range change assembly, alternative scale spans and either with or without zero shift. There is a choice of eight temperature input units with alternative scale spans, automatic cold junction compensation or external reference, and four-position range switch or miniature range-change relays with or without zero suppression. Alternatively a high impedance input unit can be supplied.

Chart drive gear boxes are of the lever-change type to which change wheels can easily be fitted giving, in all, 27 different chart speeds varying from 1 inch per hour to 3 inches per minute.

Recorders are normally supplied with a constant current supply unit which has an accuracy of ±0·1% over a 1,000 hour period. Instruments can be supplied with a speed of response of 1 sec, a guaranteed calibration accuracy of ±0·5% f.s.d. and (for high impedance instruments) a sensitivity of ±0·25% at 10 M ohms with a scale span of 15 mV.

Circle **18** *for further details.*

Spacematic 2436

THE measuring and control system of the Spacematic 2436 jig boring and milling machine has been designed by the General Electric Co. Ltd., who also manufacture the greater part of it.

The measuring system comprises two precision 10 t.p.i. hardened and ground pilot lead screws; these take no part in the mechanical positioning of the table and cross slide which is accomplished by additional power lead screws.

Each pilot lead screw carries a double nut, axially spring loaded to eliminate backlash and with a solenoid to remove the loading during high speed traverse. It is thereby ensured that no load is on the lead screw during its rotation; this not only prevents wear, but also avoids slight heating of the screw which would otherwise ensue with detriment to accuracy. Electro-magnetic pick-offs sense the position error between the pilot nuts and magnetic bars attached to the table and cross slide, and provide the input signals to the main servos. The position of each pilot nut on its screw is measured by means of a specially developed digitiser, which operates on electromagnetic principles and so has no sliding contacts to wear out. The basic unit of measurement is 0·0001 in. but this may be made 0·001 mm by substituting alternative gearing in the digitiser drive. The control system makes extensive use of transistors, and has been designed for long life and high reliability. The electronic circuits are made up on plug-in boards with printed wiring. The range of movement of the table under automatic control is 24 in. × 18 in. with an overall accuracy of ±0·0005 in. on each slide. Over shorter distances the accuracy is about ±0·00015 in.

Positioning time varies between 13 and 32 seconds, according to the distance moved, the two motions starting simultaneously.

The required co-ordinates are read into the control unit from punched cards, one card being used for each pair of co-ordinates, or they may be selected manually on two rows of decade dials. Normally the card feed is manually controlled, but an automatic feed can be fitted if required: alternatively punched paper tape may be used for this purpose. A switch is fitted to reverse the action of either axis allowing right and left hand parts to be made from the same cards or dial settings.

An important feature of the system is the arrangement for automatic zero setting. This enables the datum of the measurement system to be reset automatically for every job, so that there is no need to place the work in a precisely determined position on the table.

Automatic positioning is initiated by a single push-button, and commences with the unclamping of the slides and the starting of the pilot lead screw servos. (If no movement is demanded on one of the slides, the relevant clamp is not released.) As soon as the clamps are in the "off" position the main servos come into operation, causing the table and cross slide to follow up the movement of the pilot nuts. Both servos operate at several fixed speeds in turn; it is arranged that the final movement of each servo is always in the same direction and cannot start until the pilot nut has settled at its demanded position. The sequence concludes with the automatic clamping of the slides followed by the lighting of a signal lamp; until this occurs the pilot lead screw and table positions are continuously monitored; any errors cause the positioning sequence to be restarted. Auxiliary signal lamps enable the progress of the automatic positioning cycle to be monitored if desired.

Circle **19** *for further details.*

High Definition Photomultiplier Tube

A 14-stage photomultiplier tube has been designed specifically for use when exceptionally high definition is required in scintillation counting and nuclear radiation spectrography.

The most important requirement of a photomultiplier intended for very high definition work is that differences in the

transit times of the electrons through the tube must be negligible; otherwise the tube will not accurately resolve extremely short signals received in quick succession.

In the 56AVP, transit time differences under typical operating conditions have been kept down to 0·3 millimicrosecond. As a result, the width of the output pulse delivered by the 56AVP can be as little as 2 millimicroseconds at half height, and the rise time of the same duration.

This substantial reduction of transit time differences is due largely to a specially designed input electron-optical system consisting of the photocathode, a focusing electrode, an accelerator, and a deflector plate. The photocathode is curved so that the path lengths to the first multiplier stage are approximately equal for electrons leaving any part of its useful area. The focusing electrode and the accelerator act to concentrate the electrons into a single, narrow path, and to compensate for inequalities in their initial velocities. The deflector plate directs the electrons on to the first of the secondary cathodes.

The uniformity of transit times to the first multiplier stage is maintained throughout the tube by careful shaping of the secondary cathodes, and by additional focusing electrodes, situated between each multiplier stage, which progressively narrow the electron beam from stage to stage despite the rapid growth in the number of electrons.

With the very narrow pulses obtainable from the tube it is desirable, in the interests of economy and practicability, to dispense with an external amplifier. The 56AVP has therefore been designed to provide a peak anode current of 1 A, sufficient for direct use without further amplification. At values up to 300 mA the anode current has a linear relationship with incident light flux so that the tube can be used for measuring the energies of incident radiation. For some purposes both the initial focusing electrode and the deflector plate can be used to control the output current produced by a particular input level.

The very high anode currents delivered by the tube are made possible by a 14-stage multiplier incorporating opaque, silver magnesium secondary cathodes, and giving, under typical operating conditions, a gain of 10^8 or more, corresponding to an average cathode sensitivity of 50 microamp per lumen and an average anode sensitivity of 5,000 A per lumen.

The 56AVP is available now in limited quantities.

Circle **20** *for further details.*

Pressure Regulators

AMONG the features of the new range of pressure regulators is an improved accuracy over a wider operating range. This is coupled with greater accuracy of regulated pressure, even with widely fluctuating line pressure and rapidly varying flow, and with greater air capacity in terms of ft^3/min. These improvements have been brought about by (a) balanced valve construction, (b) greater effective diaphragm area, (c) improved baffle and syphon design, (d) larger passages, (e) larger valve openings.

Additional features include:—large filter screen enclosing valve as protection against dirt; choice of regulating springs, available as both standard or relieving type; simplified maintenance, as unit can be completely dismantled without removing from line and as access to valve parts is by hand removable valve guide plug.

Model 20AG is a standard type pressure regulator and Model 20AG-X a relieving type pressure regulator. Orders for $\frac{1}{4}$ in. and $\frac{3}{8}$ in. pressure regulators are now being filled by the new units, these will shortly be followed by the $\frac{1}{2}$ in. size units. The $\frac{3}{4}$ in. and 1 in. size units will not, however, be available until mid-summer.

All these units are available at a lower cost. Reductions in price are as much as £1 2s. 0d. in the $\frac{1}{2}$ in. size.

All orders will be automatically amended to read 20AG or 20AG-X in place of the previous 2A or 2AX. The series 2A and 2AX will, however, continue to be available, but should they be specifically required, this must be specially stated on an order.

Circle **21** *for further details.*

Differential Tachometer

A NEW tachometer which can indicate the differential speed and the identity of the faster of two shafts is the latest addition to the range of Crompton Parkinson tachometers.

The differential speed and the identity of the faster of two shafts can be indicated on a centre-zero instrument fed from two tachogenerators. For nominal shaft speeds of 1,000 r.p.m. upwards the range of indicated differential is $\pm\frac{1}{10}$ of nominal r.p.m.

For nominal shaft speeds of 1,000 r.p.m. down to 400 r.p.m. the range is constant at 100/0/100 r.p.m.

Scalings may be in any units which are a linear function of r.p.m. but percentage differential can be indicated only where one shaft is running at a constant speed.

Circle **22** *for further details.*

Space '30' Analogue Computer

THE Solartron Electronic Group Limited announce the introduction of a new general-purpose analogue computer, Space '30', which is available in desk console form. The design has been logically optimised to provide maximum utilisation of the 30 direct coupled drift-corrected amplifiers incorporated, resulting in a problem handling capacity comparable to many standard machines incorporating 40 or more amplifiers.

A central, 816-way 'Amp' detachable problem board allows for problem storage and the preparation of a problem remote from the machine.

Coefficient potentiometers, initial conditions, and function generators in the Space '30' are rapidly and accurately set-up by using a 5-digit Solartron digital voltmeter, incorporated in the control facia. The digital voltmeter also enables supplies and computing junctions to be instantly monitored to 0·1% accuracy.

Facilities are incorporated for positive problem verification, and a fully programmed machine can be rapidly checked. Manual or automatic decade scale factor changes may be programmed for the whole, or any part of the computer.

Space '30' may be used to simulate aerodynamic, hydrodynamic and thermodynamic systems; in the design of nuclear reactor controllers and subsidiary heat exchangers; for the analysis of industrial processes and evaluation of component control elements; and for the investigation of problems of vibration and structural stability.

A complete Space '30' analogue computer is priced at £10,500; delivery is three months at June, 1959. Space '30' computers can be supplied less certain operational units (for later expansion); multiple installations can also be made available.

Circle **23** *for further details.*

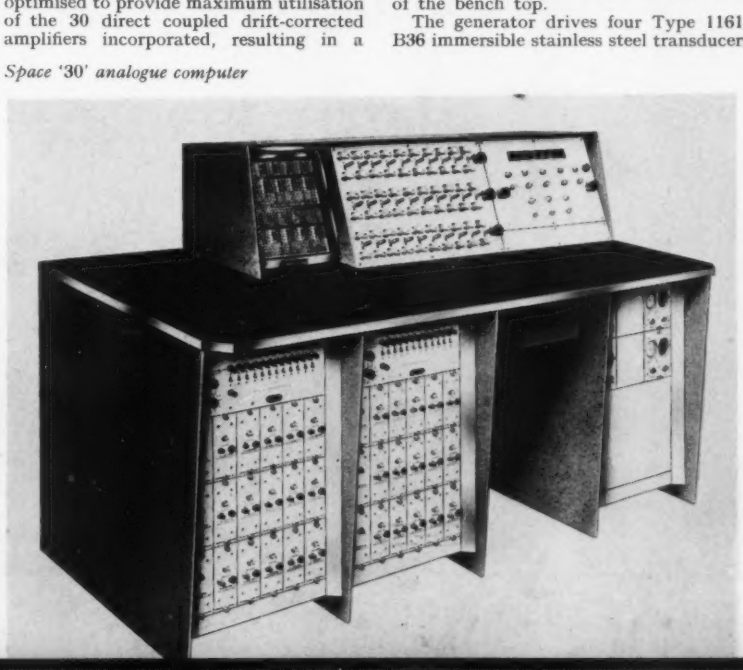
Soniclean Surgical Instrument Cleaner Type 1170

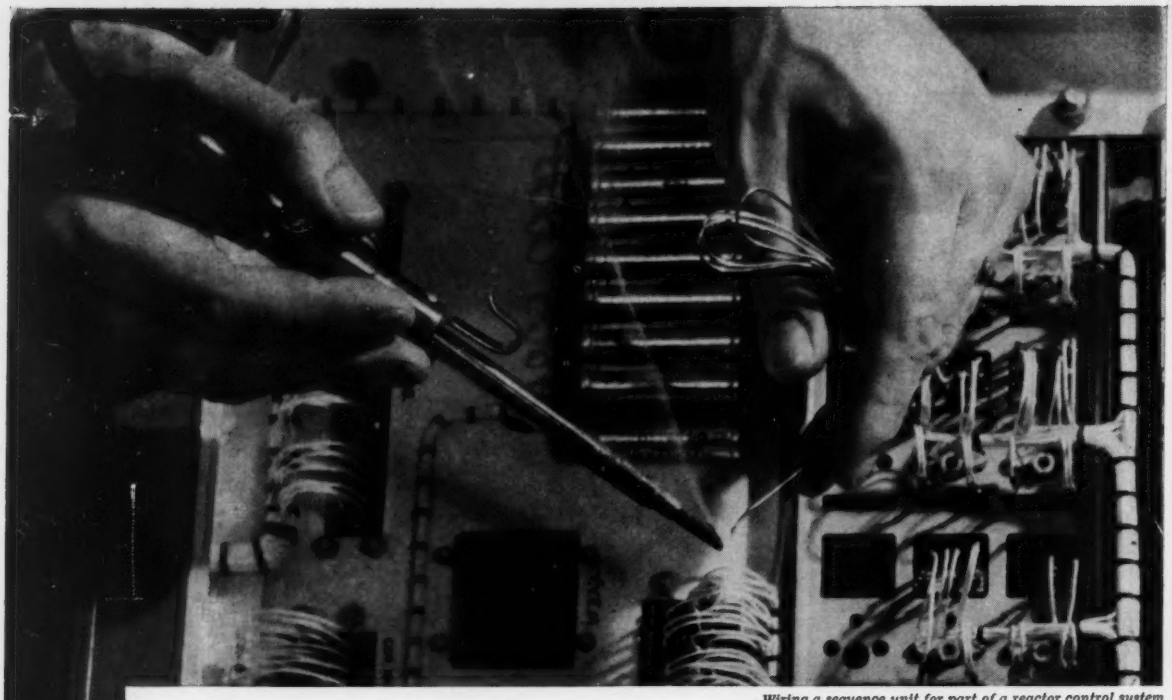
THE Soniclean surgical instrument cleaner Type 1170 consists of a rugged stainless steel cabinet with a bench top, housing a 2 kW ultrasonic generator and incorporating built-in cleaning and rinsing tanks with close fitting lids.

The generator consists of a pulsed valve oscillator operating at a frequency of 40 kc/s. This frequency has been selected since it provides efficient cleaning at low power levels, without objectionable sonic noise. The meters and electrical controls are mounted on a raised panel at the rear of the bench top.

The generator drives four Type 1161/B36 immersible stainless steel transducers

Space '30' analogue computer

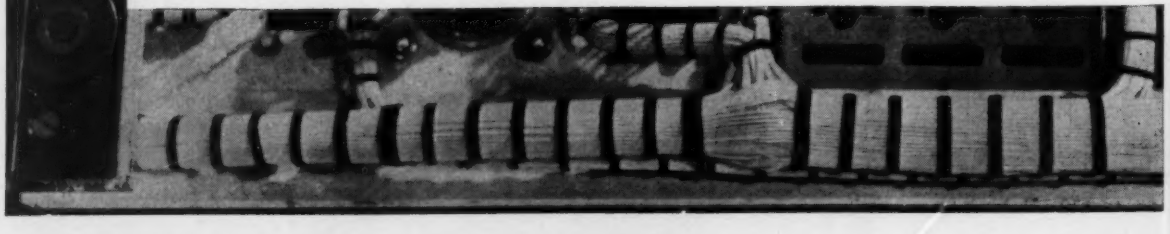


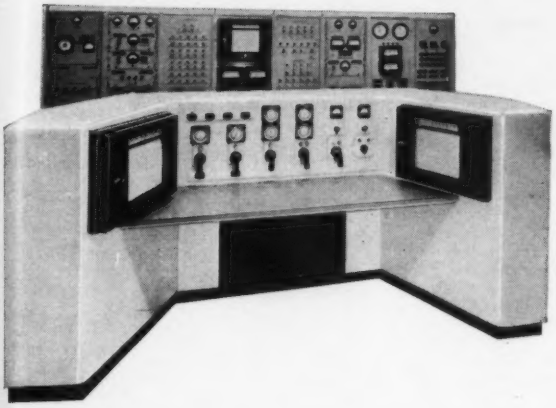


Wiring a sequence unit for part of a reactor control system

SUNVIC
–instrumental in Britain's industrial progress

Continuous improvement of instrumentation techniques is essential to progress in process control. Backed by the extensive research facilities available within A.E.I., Sunvic maintains an active policy of planned development. Sunvic introduced pneumatic force-balance instruments to this country in 1950 and has made notable contributions in other fields such as data handling and computing, reactor control systems and scientific instruments.





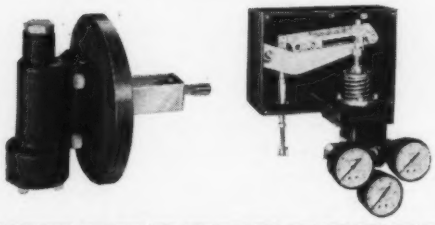
Complete systems

Equipment for research and power reactors includes instrumentation for boilers, steam and gas circuits; a range of instruments for reactor power level monitoring; safety, control and interlock circuitry and data handling systems for burst fuel cartridge detection. The illustration is of the control desk and panel for the MERLIN research reactor at A.E.I. Research Laboratories.

Pneumatics

Liquid level transmitter: weighs a displacer by true force-balance means; can also be used to measure specific gravity or interface level. Can be mounted on pipe tee or tank nozzle. Maximum static pressure 200 p.s.i. Ambient temperature limits: −40°F to +450°F.

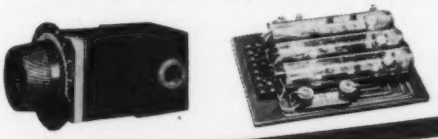
Valve Positioner: available with either lever or turnbuckle connections (illustration is of latter type with cover removed to show easy adjustment). Proportional bands of 1%, 5% or 10%. Response: with 4% valve friction, output responds to 0.1% control air pressure change.



Components and electronic systems

Energy Regulators: available in several forms with a continuous rating of 1kW at 230V A.C. and up to 6kW at 230V A.C. when used with HVS relays.

HVS (Hotwire Vacuum Switch) Relays: for switching up to 17kW, 3-phase at 440V A.C. or 10kW at 440V D.C. use. No arcing; low non-inductive operating current.



Send for details

of Sunvic pneumatics, components or nuclear instrumentation to:

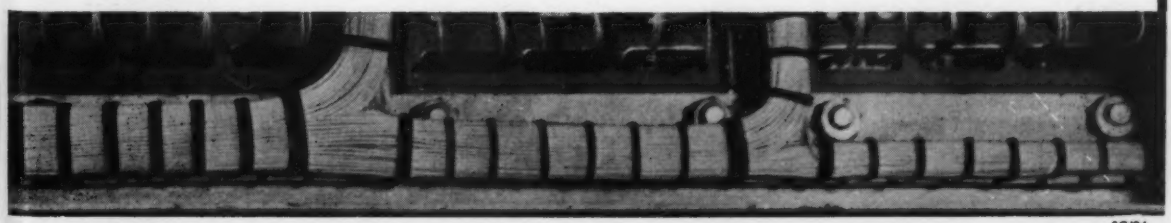
SUNVIC CONTROLS LTD

P.O. BOX 1, HARLOW, ESSEX.
TEL: HARLOW 25271

SUNVIC

An A.E.I. Company

Instruments and complete instrumentation



SC/84

which are mounted in the bottom of the cleaning tank. Both tanks are fitted with inlet valves, supplying spray rings mounted around the inside top edges. Either hot or cold water can be supplied to each tank, and outlet valves and overflow pipes are also incorporated. A detachable panel at the front of the unit gives access to the generator and plumbing.

The instruments to be cleaned are placed in a mesh basket with a sheet metal bottom, which is immersed in a solvent contained by the cleaning tank. After cleaning, the articles are rinsed in the other tank.

Care must be taken with the choice of solvents in direct contact with the stainless steel since the chemical action of liquids, which normally show only slight attack, is considerably accelerated by the ultrasonic agitation. The common acids, nitric, sulphuric and hydrochloric, must not be used for direct contact with the tanks or transducers.

The whole unit is constructed from stainless steel, and is mounted on robust swivel type ball bearing castors.

Circle **24** *for further details.*

Proportional Temperature Controller S.R.I

THE C.N.S. saturable reactor type proportional temperature controller has been produced to meet the need for a temperature controller of simple operation, with no moving parts which will provide close control of furnace temperature without the additional cost of the variable mains transformer, the mains shunt resistance and the relay which are standard in most furnace control equipment.

The controller is operated by a resistance thermometer whose change of resistance with temperature is used in a bridge system to give a continuously variable current which governs the output of a saturable reactor or transductor. This controlling current varies from 5 to 100 milliamp d.c. with a load of 2,500 ohms maximum.

The controller is used in conjunction with a reactor of suitable size for the particular furnace (generally ½, 1, 1½, or 2 kVA). Used with a 1 kVA reactor the power supply to a furnace can be set from 200 VA to 1 kVA by adjustment of the bridge precision potentiometer. After this setting any variations in the resistance of the thermometer due to temperature changes in the furnace will readjust the current to maintain constant temperature. A 1% change in absolute temperature is sufficient to swing the control current from its maximum to its minimum value and temperature errors which would occur without the controller are reduced by a factor of 600 approximately, whether they are due to mains voltage variations, ambient temperature changes or varying thermal constants. This means that the overall effect of a mains voltage change of 5% on a furnace operating at say 700°C can be reduced to within ±0·2°C.

The controller has an additional facility in that it has compensation for mains voltage variations which comes into effect instantly, thereby anticipating the signal from the resistance thermometer and stabilising the furnace current. Because of this compensation, transient errors in temperature due to thermal lag are reduced to a minimum.

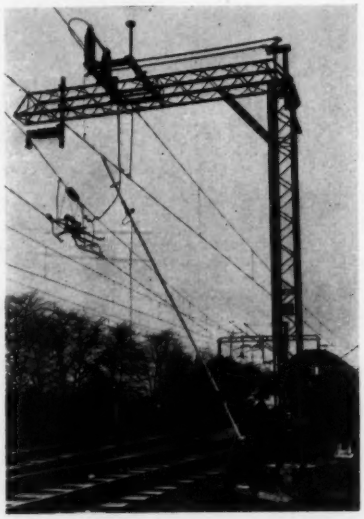
Saturable reactors are available with the controller which will enable almost any furnace or oven to be run directly from the mains supply, whether 110 or 240 V, and the need to switch or control all or any part of the current to the furnace is completely unnecessary with consequent saving on installation costs, complexity and liability to failure.

Setting of the furnace temperature requires the operation of one control knob only and the range of temperature which can be covered, using only one resistance thermometer, is approximately 800°C.

Circle **25** *for further details.*

High-voltage Indicator for Measuring Voltages on Railway 25 kV Overhead Lines

AT the request of British Railways, Ferranti Limited have developed a high-voltage indicator for measuring the voltages on railway 25 kV a.c. overhead lines. The indicator can distinguish between d.c. static, ordinary a.c. and induced voltages.



High voltage indicator for railway overhead lines

Of the electrostatic type, the indicator has two ranges, 0-15 kV and 0-30 kV, the accuracy being approximately ±5% of full scale.

To facilitate reading from below, the scale is marked with black figures in bold characters on a white background, and the angle of the voltmeter can be varied to suit requirements.

The new high-voltage indicator is basically similar to the conventional Ferranti indicators, except that the testing head can be hooked over the conductor under test. An insulated disc on the rod prevents over-shooting of the conductor.

The testing rod comprises three separate sections, each about four feet long. The top section carrying the steel hook is made of thick high-grade bakelised paper and the remaining sections are of fibreglass.

The complete equipment, i.e., testing rod, 2½ in. dial electrostatic voltmeter and flexible earthing lead can be easily dismantled and packed in a lightweight carrying case.

Circle **26** *for further details.*

Shock-resistant Vidicon

THE new RCA-7263 Vidicon has been tested under environmental conditions according to the techniques of military specifications MIL-E-5272B and MIL-E-5400.

The internal structure of the 7263 is reinforced against shock and vibration by multiple bulb supports and glass beading that locks electrodes in permanent relation to each other.

Facilitating the design of transistorised TV cameras, the 7263 has an overall length of only 5½ in. utilises a low-power heater requiring only 6/10 watt, ⅓ less than that of any other commercial Vidicon, and features fast cathode warm-up time.

The 7263 utilises a photoconductive surface having high effective sensitivity over the entire scanned area and can produce pictures of broadcast quality with as little as one footcandle of highlight illumination on its faceplate. Other features of the 7263 include an envelope without a side tip, resolution capability of about 600 television lines, and freedom of operation in any position.

Circle **27** *for further details.*

Condensers

THE following condensers have recently been added to the range made by T.C.C.

Tantalum anode condensers of polarised and non-polarised plain foil for operation between −55 and +125°C.

Miniature tubular electrolytic condensers suitable for mounting on printed circuit panels and able to work satisfactorily at 70°C without voltage derating.

Sub-miniature tubular electrolytic condensers with capacities from 0·1 to 50 μF.

Miniature tubular paper condensers with a temperature range −30 to +60°C, working voltage 150 V d.c., and range of capacity of 0·02 to 0·5 μF.

Ceramic condensers conforming to requirements of B.S.415, 1957, and B.S. 2818, 1957.

Metalised Melinex condensers for operation in the range −40 to +125°C. These condensers are applicable for most types of industrial equipment and especially for military and aeronautical work where extremes of temperature and humidity are encountered.

P.t.f.e. dielectric tubular condensers for use in a temperature range of −55 to +200°C.

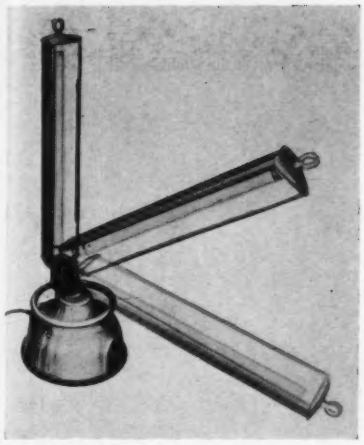
Circle **28** *for further details.*

Shadowfree Adjustable Worklight

THE "Allen" A.103 series of worklights are portable and adjustable fluorescent lights specially designed to provide wiremen, fitters and maintenance staff with high quality lighting.

Now added to the series is a new safety model primarily for use in telephone exchanges, relay rooms, control rooms, radio stations and similar electrical installations.

This new model, the Type A.103/D, consists of a 2 ft 20 watt fluorescent tube contained in a metal reflector with a clear



"Allen" L.103 worklight

front protective panel of "Perspex" or armour plate glass. The reflector is attached at one end by means of an adjustable joint to a hollow cast base which contains the control gear. The reflector can be positioned to throw light on to the job from any direction.

The electrical equipment is double insulated in accordance with B.S.2754 so that the light can be used in places where conventionally insulated fittings under fault conditions would be extremely hazardous to both personnel and equipment.

The Standard Model is for 200/250 V 50 cycle a.c., but lights are available for non-standard voltages and frequencies.

The price of the A.103/D is £24 and delivery is approximately six weeks.

Circle **29** *for further details.*

Drift Transistors

THREE new drift transistors of the germanium p-n-p type have been designed specifically for applications in automobile receivers: the 2N640 for radio-frequency amplifier service, the 2N641 for 262·5 kc/s or 455 kc/s intermediate-frequency amplifier service, and the 2N642 for converter service.

The 2N640, 2N641, and 2N642 utilise flexible leads and are hermetically sealed in metal cases having the dimensions of the JEDEC No. TO-7 outline.

Circle **30** *for further details.*

Electrolytic Conductivity Recorder, Indicator and Controller, Type RIC3

THE Type RIC3 electrolytic conductivity recorder, incorporating automatic control facilities, has been designed to automatically and precisely measure, indicate and record conductivity of electrolytes.

The basic instrument is an automatically self-balancing a.c. measuring bridge, which employs as the measuring element a conductivity cell, of patented design, that isolates a specific volume of the electrolyte in which it is immersed. Variations of electrolytic conductivity cause the measuring bridge to become unbalanced; the resulting a.c. potential, which appears at the output of the bridge, is sensitively detected by an electronic amplifier. The output of the amplifier is applied to the "signal" winding of a double-wound induction motor. The phase of the amplified "signal" is determined by the sign of the conductivity change: and the phase relationship between the "signal" and a fixed reference a.c. potential, continuously applied to the second winding of the motor, determines the direction that the motor must rotate to drive the measuring bridge slidewire to restore balance.

The indicating dial and recording pen are mechanically coupled to the slidewire shaft; by such means they are caused to indicate and record the conductivity changes as they occur.

The applications of the instrument are manifold, a commonplace example being the recording and indication of conductivity of steam condensate and heat exchange media, of which the continual purity is of the utmost importance in the effective and safe operation of large plant.

The control facilities provided in the instrument enable the condensate, or other electrolyte being monitored to be diverted to waste in the event of contamination. The equipment is also extensively used to supervise the efficiency of rinsing, and to admit diluting water only when necessary, thereby saving vast quantities of good water which would otherwise be needlessly run to waste.

A noteworthy application of the Type RIC3 instrument is the completely automatic control and indication of conductivity in plant used for the purification of brackish water by electrodialysis, in parts of the world where water in its natural state is virtually unusable because of the high salt content.

Circle **31** *for further details.*

BICC Mineral Insulated Thermocouples

BRITISH INSULATED CALLENDER'S CABLES LIMITED, who have for some time been manufacturing mineral insulated cables, are now applying the principle of mineral insulation to thermocouple production. The thermocouples consist of two dissimilar thermo-electric conductors, welded together at a point (the hot junction), embedded in highly compressed magnesium oxide insulant, and completely encased in a seamless, circular, stainless steel sheath.

When heat is applied to the hot end a small voltage is generated, and detected, via a compensating lead, by a suitable measuring device. This voltage is proportional to the temperature causing it and thus the meter can be calibrated to provide a direct temperature reading.

The positive conductor is of nickel-chromium alloy and the negative conductor of nickel-aluminium alloy.

They are available in standard overall diameter sizes of 0·122 in. and 0·060 in., but intermediate sizes are also available.

Circle **32** *for further details.*

N-P-N Junction Transistor

RCA-2N649 is an alloy-junction transistor of the germanium n-p-n type. It is designed for use along with its p-n-p counterpart, RCA-2N408, in class B complementary symmetry power output stages of compact, transformerless battery-operated portable radio receivers, phonographs, and audio amplifiers operating at battery-supply voltages up to nine volts. In such equipment, the 2N649 ensures good frequency response and relatively high power output at low cost. This transistor may also be used in conventional class B push-pull and in class A audio amplifier circuits.

The 2N649 has a d.c. current gain which is essentially constant over the operating current range to ensure circuit linearity, and a collector cutoff current of only 14 microamperes to ensure stable performance under varying ambient temperature.

The 2N649 has flexible leads and is hermetically sealed in a metal case having dimensions which conform to the JEDEC No. TO-1 outline.

Circle **33** *for further details.*

Photo-electric Flow Alarm for Industrial Rotameters Type 907 and 914

THE alarm comprises a light source (6 V 6 W bulb run at 4 V) and a photo-conductive cell (Mullard ORP11 cadmium sulphide). Each is housed in an identical black plastic moulding which clamps to diametrically opposite pillars of the chassis. Independent adjustments allow the alarm to be set at the required height and also to align the axes of the lamp and photo-cell centrally through the Rotameter tube. Thus, the alarm may be mounted on any size of frame in the types 907 and 914 series.

When light from the lamp falls on the photo-cell its resistance falls and allows the passage of sufficient current to operate the relay, coupled to a micro switch (5 A 230 V a.c. rating). When the Rotameter float obscures the light, the resistance of the photo-cell increases, thus reducing the current, closing the relay, and operating the micro switch, which makes one contact and breaks another.

As the smallest size of float does not fully obscure the ray of light, a restrictor is supplied to fit over the nose of the photo-cell housing to reduce the diameter of the ray in this case.

When used for alarm at minimum flow, alarm will be given when the bottom of the float obscures the light beam, which will not necessarily correspond with the minimum capacity of the instrument.

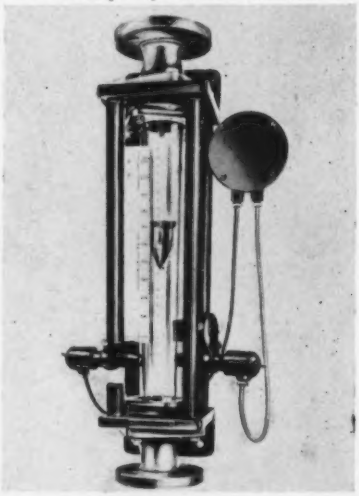


Photo-electric alarm fitted to Rotameter Type 907

Leads from the lamp and photo-cell are fed to a separate junction box clamped to the chassis. Connection must then be made to the relay box which contains a mains transformer, an alarm relay, and a rectifier. Choice of mains voltage tappings is provided.

The lamp is under-run, and the length and therefore the resistance of the lead from the junction box to the relay box affects the brightness of the lamp, a selection plug in the relay box allows appropriate adjustment of the power fed to the lamp.

Automatic or manual reset is optional.

The relay and power supply unit are housed in a robust steel case which measures approximately 7½ in. × 4½ in. × 5 in., and has wall mounting lugs.

Circle **34** *for further details.*

"Douglas" Supermatic Coil Winding Machine

To enable precise winding of layers of wire to be practically achieved, a new form of winding machine has been developed which has separate electrical drives for the headstock and traverse, which are not mechanically coupled by normal gearing. The desired speed ratio to be maintained between the two drives is produced electronically, and controlled by a sensing head which, in effect, senses when any one turn of the winding is not being laid in juxtaposition to the preceding turn and tends immediately and automatically to correct the speed ratio between the two drives, so that this condition is rectified.

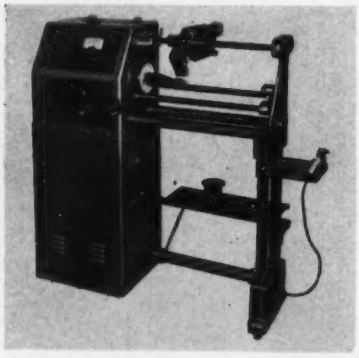
The machine will only allow the wire to be wound in one direction on any one layer so that if a small gap between turns is not completely corrected, the wire will not become trapped and reverse direction, but will continue to wind in the correct direction, thus minimising the effect of the fault on a layer. Reversal at the end of the predetermined layer is electrical and virtually instantaneous.

The result of this is that it has become possible to wind almost perfect layer wound coils over a wide range of wire gauges even down to thin wires of the order of 0·002 in. (0·0508 mm) diameter.

The speed of winding will not approach the high mass production speeds achieved on certain existing machines but, nevertheless, depending on the nature of the coil, quite high winding speeds can be obtained.

By a simple adjustment of the sensing head, the machine can also be made to wind spaced turn coils (single layer), with a very close control of the interwire spacing.

Circle **35** *for further details.*



"Douglas" Supermatic coil winding machine

Transformers

A RANGE of resin cast transformers operating between 5 and 350 VA at power frequencies have been designed and manufactured to comply with the requirements of RCS 214 and are fully interchangeable in all respects with others made to this specification. Sample transformers have successfully withstood repeated cycling between −60°C and 110°C.

The wound bobbins are vacuum impregnated with polyester resin, and finally cast in a type of black epoxy resin which does not support combustion. Solid block construction ensures high resistance to mechanical shock and internal pressures. Terminations are gold plated to reduce the risk of dry joints on assembly. Primaries are wound to cover 200-250 V in 10 V steps, unless otherwise specified. All windings are designed to withstand a minimum pressure of 2,000 V r.m.s. between each other and to core. Insulation resistance is maintained to better than 100 megohms up to 130°C. A copper screen between primary and secondaries is provided as standard.

Circle **36** *for further details.*

Resin cast transformers

Model 30AF and 30AD Air Filters

IMPROVEMENTS to the 30AF series of manual drain air filters have reduced the number of loose pieces when the filter is dismantled for cleaning the filter element. The filter element is retained in place by a long stud which enters into the body. This stud is now permanently ring staked into the body and the filter element is secured in place by the baffle. The baffle is a new moulding in nylon and the thread by which it screws on to the stud is so formed as to produce a self-locking action.

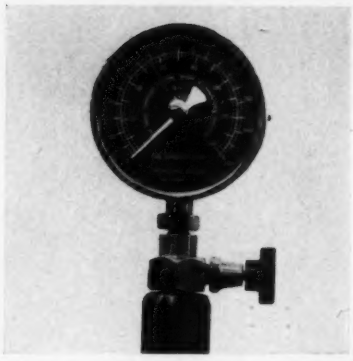
The result is that in taking the element out for cleaning, one only has two other loose pieces, namely the baffle plate and the bowl with clamp ring.

This modification is being introduced without change of Model number or change of price and also applies to the simpler 30AD series of filters. Amended spare parts price list and operating and maintenance leaflet will be issued in due course.

Circle **37** *for further details.*

Peak Pressure Indicator

THIS instrument, styled the Diesindicator, has been designed to register accurate peak and initial cylinder pressures upon a clear dial-type gauge and thus provides immediate visual readings not possible with non-dial forms of indicator, without the need for making complicated adjustments before or during use.



Diesindicator

It is suitable for low, medium and high-speed diesel engines where access to the combustion chamber is provided; it is applied simply and quickly and can be used either in vertical or horizontal positions.

As no piston or damper is incorporated, not only is inertia minimised but, in practice, carbon deposit is very greatly reduced with the result that the instrument will continue to operate effectively over long periods without the need for dismantling and cleaning.

The 2,000 lb gauge, graduated both in lb/in² and kg/cm², is housed in a steel case fitted with a special Bourdon tube. As the accuracy of the instrument depends on the gauge, every individual gauge is deadweight tested and every assembled instrument is subjected to a dynamic test before final inspection.

The Diesindicator is supplied in a polished wooden instrument case, complete with male and female connectors for standard compression cocks, special spanners and spares and cleaning wires required for servicing and valve cartridge.

Circle **38** *for further details.*

A 2,000 Card a Minute IBM Sorter

IBM announce a new alpha-numeric sorter, the IBM 084, which can sort punched cards at the rate of 2,000 cards a minute.

This high speed is made possible by transistorised circuits. Photo-electric sensing replaces the standard sorting brush. An electric beam passes through a punched hole and sets up a transistor circuit which guides the card into its proper stack.

Circle **39** *for further details.*

Magic Marker

A marking system, the Magic Marker, uses ink which dries instantly and is both smudge-proof and waterproof.

The Magic Marker will write on foil, wood, rubber, glass, plastics, leather, fabrics, stone and all other surfaces. The ink is fadeless and so can be used out-of-doors in any climatic conditions.

Circle **40** *for further details.*

Whatever your measurement problem there is almost inevitably a precision-engineered Solartron instrument which will give you a rapid, accurate solution. Whether at ultra-low or microwave frequencies, high accuracy of indication, stability of performance and use of the most up-to-date design techniques and components characterise all Solartron instruments.

Here are just three — featured against their respective meter scaling.

ABSOLUTE MEASUREMENT

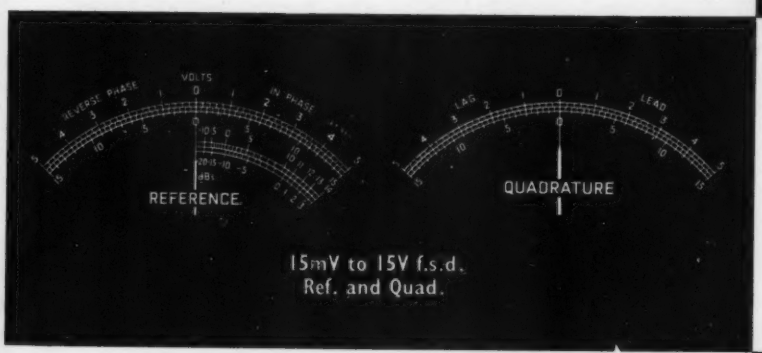
by Precision A.C. Millivoltmeter

Nine ranges: 1·5mV to 150V, f.s.d.
1% accuracy f.s.d. 10c/s to 100Kc/s.
50 megohms nominal input resistance.
Additional db scaling neg. 80db to + 34db.
Incorporates high-stability power supply.

VECTORIAL MEASUREMENT

by Resolved Components Indicator

Frequency range 20c/s to 20Kc/s (0.1c/s to 1Kc/s with VP 253·2).
Direct readings in Cartesian co-ordinates plus db Reference scale.
Built-in reference system gives complete harmonic discrimination.
Noise and harmonic rejection ➤ 40db.
Better than 50 megohms input resistance.



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RELATIVE MEASUREMENT

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Overall range from neg. 70 to ± 36db.
Accuracy ±0·25db 15c/s to 100Kc/s (±1db 10c/s to 250Kc/s).
For 75, 150 or 600 ohm line testing.
Balanced or unbalanced, open or terminated measurement.

Circle 49 for further information

a NEW
HIGH SPEED
PANEL MOUNTING
ELECTRO-MAGNETIC
COUNTER

NOW
With
INSTANT
ELECTRIC
RESET

★ *This counter can be supplied with the first wheel graduated 0 to 9 or 0 to 11 as standard.*

This counter embodies all the well tried features of our Type 100 Electric Counters, plus electric reset. This form of reset is particularly useful where a number of counters are required to be reset at the same time.
Coils for both resetting and counting can be supplied for operation on the following voltages:—

24/48 volts D.C., 110/115 volts A.C. 50 and 60 cycles, and 230/250 volts A.C. 50 cycles. A further model is now available with improved push-button manual resetting facilities which ensure that the counter is virtually sealed.

Counting Instruments Ltd

Write for full details.

COUNTING INSTRUMENTS LTD., 5 Elstree Way, Boreham Wood, Herts.
Tel.: ELStree 1382 (4 lines)

NEWS OF THE INDUSTRY

New Laboratories for Coil Spring Research

NEW laboratories for the Coil Spring Federation Research Organisation at Sheffield, which will be ready in July, will be among the most comprehensive of their kind in the world. They will enable research to be carried out on springs made from the finest wires to bars of up to 2 in. diameter. In addition to work on springs and torsion bars, research will be possible on materials in wire and strip form. Metallurgical research will also be undertaken on a very wide range of ferrous and non-ferrous alloys.

A major feature of the new buildings will be a comprehensive electro-plating laboratory, which has been presented to the C.S.F.R.O. by Messrs. W. Canning and Co. Ltd., of Birmingham. Cannings have accepted the organisation's invitation to become Honorary Associate Members. The new electroplating laboratory will enable further work to be done in the field of hydrogen embrittlement.

The effect of non-metallic coatings on fatigue life is being studied. So far tensile, hardness, abrasion and corrosion tests have been devised for thin films and carried out on thirteen different resin and plastic protective materials.

The research programme for this year also includes work to determine the influence of type of material, heat treatment and surface finish on the fatigue life of heavy duty springs.

Duke of Edinburgh to be Patron of I.E.A.

HIS ROYAL HIGHNESS PRINCE PHILIP, the Duke of Edinburgh, K.G., has graciously consented to become Patron of the Instruments, Electronics and Automation Exhibition, which will be held at Olympia London, next year.

I.E.A. Representatives Return from European Tour

THREE representatives of the I.E.A. Exhibition have recently returned from a 3,000 mile tour of Europe, including Copenhagen, Dusseldorf, Frankfurt, Munich, Milan and Paris.

Stresa Nuclear Energy Conference

DR. DENIS TAYLOR, M.Sc., PH.D., M.I.E.E., a director of Plessey Nucleonics Limited, spoke on the subject of Instrumentation at the European Conference for Industrial Management on Industrial Projects in Nuclear Energy.

The conference, which was arranged by the Organisation for European Economic Co-operation, took place at Stresa, Italy, 11th-14th May, 1959.

Dr. Taylor was in company with other speakers from the United Kingdom, among whom were Sir William Cook and Mr. D. M. Peirson of the United Kingdom Atomic Energy Authority.

NPL Annual Report, 1958

THE recent reorganisation at the National Physical Laboratory and the consequent new trends in its research work are outlined in the Annual Report for 1958.

The replacement of three of the old Divisions by the new Divisions of Applied Physics, Basic Physics and Standards has enabled the Laboratory to plan research into new fields. The new Basic Physics Division is equipping itself to begin work mainly devoted to the relation between the macroscopic properties of materials and their structure on a molecular scale. In the Applied Physics Division, work has begun on radio-carbon dating and a national centre for neutron source standardisation is being formed.

A new item in the Standards Division is the accurate determination of the gyromagnetic ratio of the proton which will open the way to precise measurement of strong magnetic fields and hence to the accurate determination of a number of important fundamental constants.

Other new aspects of the programme include the increasing attention of the Aero dynamics Division to the behaviour of gases at the high temperatures associated with high speed flight, and to the development by the Control Mechanisms and Electronics Division of new components for very high-speed computers.

The Light Division has made progress with the application of gratings to linear and angular measurement and to the control of machine tools.

The Metallurgy Division has been concentrating particularly on fine structures of metals, movements of dislocations and their relation to physical and mechanical properties.

A group is being set up in the Mathematics Division to consider the theoretical aspects of experimental work being carried out in other Divisions.

In future greater attention will be given to problems connected with the seagoing qualities of ships in rough water. This work is being carried out in co-operation with the British Shipbuilding Research Association, the Admiralty, and the National Institute of Oceanography.

Staff are already at work in the new Ship Hydrodynamics Laboratory, which is nearing completion at Feltham. It is hoped that the Laboratory will be in full use by the end of this year.

R.I.C. Specifications becoming British Standards

SPECIFICATIONS, published by the Radio Industry Council over the period 1949 to 1953 for use by industry with the intention of their eventually becoming British Standards, have been withdrawn and work is proceeding as quickly as possible on their revision and submission to the British Standards Institution.

One R.I.C. specification, dealing with electrolytic capacitors, has already been revised and issued as a British Standard (B.S.2134).

Two more:—

Resistors, Fixed, Carbon
Ceramic Capacitors, Type 1

are in the printers' hands, and another:—

Resistors, Fixed, Wirewound

has been approved by the B.S.I. Technical Committee.

Specifications awaiting final industry comments are:—

Resistors, Variable, Composition
Ceramic Capacitors, Type 2
Capacitors, Mica, Fixed
Climatic and Durability Testing,

and drafts of the following have been circulated for comment:—

Capacitors, Metallised Paper, Fixed
R/F Cables
Valveholders
Screening cans for valves.

The following are in earlier stages of progress:—

Resistors, Variable, Wirewound; Capacitors, Variable; Connectors; Transformers; Cartridge Fuses; Wafer Switches; Toggle Switches; Terminals; and Ceramic Insulators.

The Radio and Electronic Component Manufacturers' Federation and the British Radio Equipment Manufacturers' Association, both constituent associations of the R.I.C., and the Electronic Engineering Association, are all concerned in progressing the new specifications.

IBM European Educational Centre

As part of their world-wide educational programme, IBM have opened a European educational centre at Blaricum near Amsterdam, in Holland. It is a residential centre which can accommodate up to 40 guests. Seminars for executives from all West European countries will be run each week throughout the year, and will each deal with specialised subjects or specific industries and applications.

Forthcoming seminars will cover banking and insurance, the chemical, steel, railway and petroleum industries. Seminars will also be held for planning, manufacturing and research engineers, and for special groups such as university professors.

Seminars will be conducted in English, French and German and speakers will be both from IBM and IBM-users. An

Circle 50 for further information

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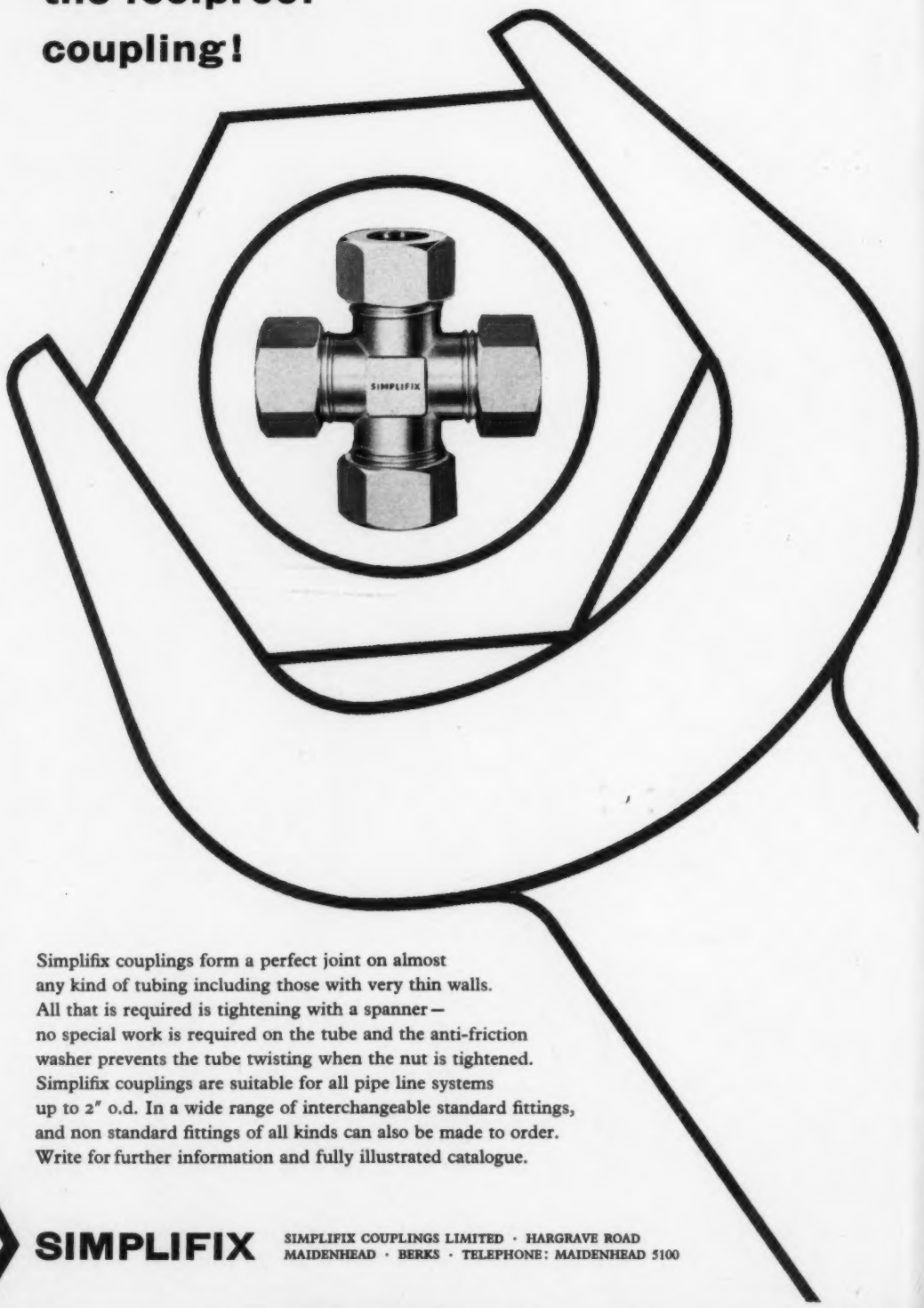

Simplifix couplings form a perfect joint on almost any kind of tubing including those with very thin walls. All that is required is tightening with a spanner — no special work is required on the tube and the anti-friction washer prevents the tube twisting when the nut is tightened. Simplifix couplings are suitable for all pipe line systems up to 2″ o.d. In a wide range of interchangeable standard fittings, and non standard fittings of all kinds can also be made to order. Write for further information and fully illustrated catalogue.

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opportunity is thus provided for the sharing of experience in the different European countries.

IBM feels its extensive programme of education to be of the greatest importance in keeping pace with developments in data processing, and in meeting the growing awareness of its implications. In 1958 alone over 30,000 people attended courses lasting from one day to four weeks in 17 European countries.

Belling-Lee Research Engineer at American Components Conference

THE subject for the 1959 Electronic Components Conference was "New Concepts for the Space Age". The conference took place in Philadelphia on 6th to 8th May, and was organised by the I.R.E., the A.I.E.E. (American Institute of Electrical Engineers), the E.I.A. (Electronic Industries Association) and the West Coast Electronic Manufacturers' Association.

One of the two British scientists speaking at the conference was Mr. I. A. Davidson, B.A. (Cantab.), who is a senior research engineer with Belling & Lee Limited. The subject of his paper was "The Liability of Plugs and Sockets in Rockets and Space Vehicles".

Third Industrial Electronics Exhibition

THIS exhibition, organised by Farnell Instruments Ltd., was held at Newcastle-upon-Tyne from 26th to 29th May. Among the firms exhibiting were Advance Components, Avo, Cossor Instruments, Dawe Instruments, Electronic Switchgear (London) Ltd., E.M.I. Electronics, Farnell Instruments, British Ferrograph Recorder Co. Ltd., Furzehill Laboratories, Grünther Instruments, Microwave Instruments, Nagard, Nash & Thompson, Racal Engineering, A. V. Roe, Siemens Edison Swan, Stonebridge Electrical, Taylor Electrical Instruments, Telequipment, Westool, and Belling & Lee.

R. B. Pullin Show

AN exhibition was staged to show Pullin Group employees the products manufactured and supplied by the Pullin Group. It extended over two days and was seen by more than 1,000 employees.

New Products in Scotland

LAST December the D.S.I.R. asked for suggestions from Scottish firms for new products and new processes to be shown on the Department's stand at the Scottish Industries Exhibition in September. The products of seventeen companies have now been selected.

These include:

Honeywell Controls Ltd.,
Newhouse,
Motherwell,
Larnarkshire,

who will be exhibiting an automatic data processing unit.

W. B. Nicholson (Scientific Instruments) Ltd.,
Thornliebank Industrial Estate,
Glasgow,

who will be showing a Van de Graaff electrostatic generator for use in schools. The need for a simple, cheap and non-lethal classroom apparatus is met by this instrument, which sells at about £50 compared with the £200,000 cost, a true Van de Graaff machine,

and

James Scott & Co. (Electrical Engineers) Ltd.,
68 Brockville Street,
Carntyne Industrial Estate,
Glasgow, E.2,

who will feature a spectrum analyser, a sensitive instrument with a frequency range of 1 to 90 kc/s.

Irradiated Polythene Cables for Rocket Research

BRITISH INSULATED CALLENDER'S CABLES LIMITED have recently supplied a range of multi-core irradiated polythene cables for use at the new rocket research establishment at Spadeadam, Cumberland.

The cables themselves have been supplied in various sizes, and basically consist of stranded conductors insulated with high density polythene, the cores being laid together, screened overall with braid and polythene over-sheathed. The completed cable is then passed continuously through an electron beam, the source of irradiation being provided by a 2,000,000 volt Van de Graaff electrostatic particle accelerator.

The cables are required to operate during short-term high temperature conditions, and BICC irradiated polythene cables, which were specially developed for this purpose, provided the most economic solution. It is the first time that manufacture of this type of cable has been carried out in Great Britain.

Level Detectors and Controllers: Patent Agreement

FIELDEN ELECTRONICS LIMITED and Lancashire Dynamo Electronic Products Limited announce, pursuant to agreement reached between them, that no level control equipment manufactured or produced by Lancashire Dynamo Electronic Products Limited of a type now or previously manufactured or produced by them nor the use of the same in any manner for level detection or control shall by agreement be regarded as infringing or having infringed any of the patents or patent applications of Fielden Electronics Limited.

Similarly, no level control equipment manufactured or produced by Fielden Electronics Limited of a type now or previously manufactured or produced by them nor the use of the same in any manner for level detection or control shall by agreement be regarded as infringing or having infringed any of the patents or patent applications of Lancashire Dynamo Electronic Products Limited.

It is emphasised that the foregoing announcement is made as a result of the above-mentioned agreement and that it is strictly confined to the products of Lancashire Dynamo Electronic Products Limited and Fielden Electronics Limited respectively.

Ferranti Anechoic Chamber

As part of an intensive two-year research programme into the causes of transformer noise, the Distribution Transformer Department of Ferranti Ltd., at West Gorton, Manchester, have recently completed a new anechoic chamber.

The completed anechoic chamber

The research programme is being undertaken as a result of the Electricity Board/BEAMA Sub-Committee proposals that manufacturers should take measurements of noise emitted from transformers with a view to the eventual specification of maximum sound levels for transformers ranging from 1,000 kVA to 100,000 kVA. Research work on noise from large power transformers has been proceeding at the company's Hollinwood factory for a number of years, but it was decided that independent investigations should be carried out on distribution transformers.

The double-walled brick chamber is located within the factory in the existing production line, so that, in testing procedures visualised for the future, the transformers having previously undergone routine tests would then pass through the chamber for noise level tests before being packed ready for despatch.

The double brick wall construction ensures that no airborne noises are admitted.

Groundborne noises have also been taken into consideration and to prevent these affecting measurements taken inside the chamber, the inner shell of the chamber is built on a "floating" concrete base resting on a thick cork membrane. The chamber has been made sufficiently large so that anechoic wedges can be fitted if required.

Provision has also been made for doors leading into and out of the chamber to have a filling of glass wool to act as an absorbent for sound, and the tracks conveying transformers to and from the chamber are broken at the line of the door in order to make a soundproof seal. All noise measurements are taken in a central control office and the cable trench carrying power supply cables to transformers under test is filled with sound absorbent material.

5,000-watt Thermoelectric Generator

THE BUREAU OF SHIPS, United States Navy, has awarded Westinghouse Electric Corporation a contract to "design, construct, test and furnish a five-kilowatt (5,000-watt) thermoelectric generator".

The generator, which will convert the heat of a burning fuel directly into electricity, will have a power output larger than that of any generator of this type known to have been constructed.

Construction of the generator, Westinghouse officials said, is the first step in solving material selection, fabrication, assembly, and operating and control

Circle 51 for further information

2 CHANNELS FOR THE SPACE OF ONE

The New Twin Quadrant Fader

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1959 R.E.C.M.F. EXHIBITION

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2 Networks in panel cut out 5" x 1 13/32"

Channel cueing by colour changing illuminated translucent scales.

Plug-in networks.

Three change-over auxiliary switches available on each network.

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problems of a large-scale thermoelectric power plant.

The heat source to power the new thermoelectric generator will be a fuel readily available to the Navy. Diesel oil or other Navy fuel oil will likely be used.

Thermoelectric power generation requires that a difference in temperature be maintained across the thermoelectric materials which, when heated, produce electricity. The cool side of the Westinghouse generator will be maintained by cooling with water. Ordinary sea water will be used directly, if possible, although fresh water, cooled by sea water in a heat exchanger, will be used if necessary.

The electrical output of the new generator will be such that it will operate existing Navy electrical equipment. The generator will operate with maximum quietness and will be designed for maximum shock and vibration resistance.

The utmost in flexibility will be built into the new thermoelectric power plant. Although intended to be the small-scale prototype of a shipboard installation, it may be used directly as a movable or portable power source.

The five-kilowatt generator will be designed and built by Westinghouse primarily in its central engineering laboratories.

Philips at Eindhoven

WORK has started on the construction of a new research centre for Philips at Eindhoven. The physics laboratory, which now has a staff of 1,400, will gradually be moved there as buildings are completed.

The new research centre will be housed in separate "sectors" grouped about the 250-acre site. Each sector will consist of one laboratory, one workshop and one or more special laboratories for sound or high-tension experiments.

The plans for this project were drawn up by Philips' building and engineering department, after an extensive study of recent laboratory design in Europe and the U.S.

Automatic Controls in U.S.S.R. Industry

RECENTLY a British team of experts in automatic control left the United Kingdom to study the developments and applications of automatic control techniques in industry in the U.S.S.R.

The visit, of a fortnight's duration, was arranged as a result of collaboration between the Council of The Institution of Electrical Engineers and the Soviet Relations Committee of the British Council on the one hand and The Academy of Sciences of the U.S.S.R. on the other, and reciprocated a visit to the United Kingdom during November and December, 1958, of a U.S.S.R. team of experts in the same subject.

The British team, whose individual interests are as stated, consisted of the following six members:

Academic: Professor A. Tustin, M.Sc., M.I.E.E. (Leader); Industrial Applications: Mr. A. Asbury, B.Sc., M.I.E.E.; Iron and Steel Research: Mr. S. S. Carlisle, M.Sc., A.M.I.E.E.; Control Mechanisms: Mr. P. H. Hammond, B.Sc., A.M.I.E.E.; Consultant: Mr. R. H. Tizard, B.A., M.I.E.E.; Chemical Industry: Mr. A. J. Young, B.A., B.Sc.

The team has an interest in a wide field of applications of automatic control in industrial production, including the steel, chemical, oil and electrical industries, and in marine applications. The programme, devised by the Academy of Sciences of the U.S.S.R., was framed so as to enable them to study the development work in progress towards the application of automatic control in these and other fields and to see some of the more recent installations in which these developments are being applied.

Particular examples of interest were:

(i) Machine tool control.
(ii) Telemetering systems.
(iii) The uses of digital computers or digital techniques in the control of processes or in the recording and analysis of data in process plants.
(iv) Extremum controls.

Automatic Control of Industrial Processes by Computer

THE first transistorised electronic digital computers designed to provide fully automatic control of many industrial processes are now being manufactured by Ferranti Ltd. and the first production model will be installed within the next 12 months. The new machine is called Argus and measures 5 ft × 4 ft × 2 ft

This is the first time that a transistor computer has been specifically designed for on-line process control for a variety of industrial uses, such as may be found in the power, chemical, oil, gas and steel industries and for the control of boilers during start-up and shut-down.

The basic machine is provided with 1,024 words of core store for data storage.

Production models will be available by mid-1960 and range in price from £30,000-£70,000, depending on the size of the installation and ancillary input/output requirements.

EDA Office-Bearers for 1959-60

AT the annual general meeting of the Electrical Development Association, Sir Josiah Eccles, C.B.E., M.M., D.Sc., M.Inst.C.E., M.I.Mech.E., M.I.E.E., deputy chairman of the Electricity Council, was appointed president of the Association for the year 1959/60. Messrs. A. W. Ferguson, M.C., C.A., former chief administrative officer, Electricity Board for Northern Ireland, and John Mould, O.B.E., A.M.I.E.E., former chairman, East Midlands Electricity Board, were appointed vice-presidents for the term 1959-1962.

At the first meeting of the Association's newly constituted Council, Mr. T. E. Daniel, M.Eng., M.I.E.E., A.M.I.Mech.E., chairman of the North Western Electricity Board, was elected chairman for the year 1959/60, and Mr. D. B. Irving, B.Sc.(Eng.), M.I.E.E., chairman of the London Electricity Board was elected vice-chairman.

Boiler Gas Circulator Panels

WORK at Sunvic's Harlow factory is now nearing completion on the boiler gas circulator panels scheduled for Berkeley nuclear power station. Each panel will be used for measurement and control of a gas circulator and associated heat-exchanger. They will be brought into service locally on the plant during start up, maintenance and for major plant changes.

Simmonds Aerocessories Pty. Ltd. in Australia

NEW factory buildings were opened last month at Ballarat for Simmonds Aerocessories Pty. Ltd., the Australian subsidiary of Simmonds Aerocessories Ltd., a member of the Firth Cleveland Group.

At the opening ceremony, performed by the Mayor of Ballarat, the company's managing director, Mr. H. Hanford Stevens, announced that a further extension, covering 72,000 sq. ft., would be built to link the new building with the old.

The new buildings include a main office building, which houses the executives' section, and a temporary factory area which will be used later for the extention of offices, and the first bay of the new factory building announced by Mr. Hanford Stevens.

Plessey Licensing Agreement

THE PLESSEY COMPANY LIMITED announces that an agreement providing for the manufacture of Metallux resistors in the United Kingdom has been concluded with Elettronica Metal Lux s.p.a., of Milan, Italy.

Metallux metal film resistors, already well known in this country, have been available through Plessey as sole U.K. agents during the past 18 months.

Under the new agreement, in addition to sole manufacturing rights in Britain, Plessey will hold selling rights for the United Kingdom and all Commonwealth countries.

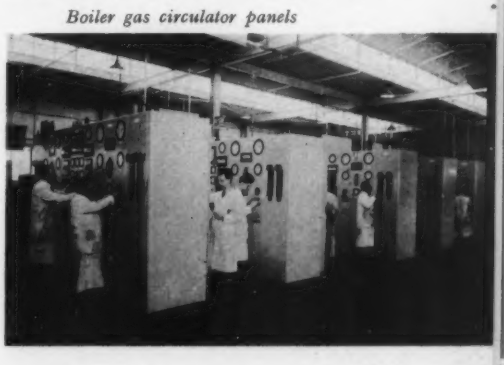
Extensive new equipment is to be installed and a separate production unit formed within the Capacitors and Resistors Division of The Plessey Company at its Kembrey Street factory at Swindon, Wilts.

Production, scheduled to start during the next few months, will make Metallux resistors more readily available in quantity in this country. Meanwhile, limited supplies will continue to be available.

Southern Instruments' Associates

SOUTHERN INSTRUMENTS LIMITED has associated itself with the Ampex Corporation of America and its U.K. subsidiary Ampex Electronics Limited, in the manufacture and marketing of Ampex tape instrumentation equipment in Great Britain. The recently extended Southern Instruments factory at Camberley, which

Boiler gas circulator panels



traditionally produces a wide range of precision electronic instruments in the recording, data handling, measurement and analytical fields, now also has the "Ansafone" telephone answering and recording machine in full-scale manufacture, in an endeavour to meet the demand for this aid to automation in home and office.

Instrument Construction

Instrument Construction is the title of the the English translation of the Russian monthly journal *Priborostroenie*. Each issue of the journal, since January, 1959, is being translated by the British Scientific Instrument Research Association for D.S.I.R. *Priborostroenie* is published in Moscow and is described as a scientific, technical and production journal. The titles of some of the articles appearing in the January issue are given below:

"Automatic control of ferroalloy furnaces by means of electrodes."
"A compact transistorised analogue computer MN-10."
"Study of membrane deflections in automatic manometers."
"Determination of the thickness of plating by measuring the thermal e.m.f."
"Instrument for control of tension in wire ropes."
"New method of measurement of small displacements."
"Contemporary semiconductor diodes and transistors of foreign make."

Enquiries concerning subscriptions should be sent to Taylor & Francis Ltd., Red Lion Court, London, E.C.4.

Elliott-Automation Autopilots for Vickers VC.10

ELLIOTT-AUTOMATION accounces that the Aviation Division of its subsidiary Elliott Brothers (London) Limited has been selected by Vickers-Armstrongs (Aircraft) Limited to supply the fully integrated dual automatic pilot, flight director and polar path compass systems for their VC.10 airliners.

These systems are designed to ensure maximum safety and reliability of a higher order than has been achieved in the past. The VC.10 aircraft is the first in the world to employ dual integrated systems using navigational and control characteristics of this advanced type.

The engineering of the systems is being carried out by the Elliott Aviation Division in collaboration with Vickers-Armstrongs and the production will take place at the Rochester, Kent, works of Elliott-Brothers (London) Limited.

The initial order for the systems amounts to a value approaching £2,000,000.

Mr. G. Bell, of Servomex Controls Ltd. discusses features of the stabiliser with (left to right) Dr. G. E. Watts, Mr. S. W. B. Leathlean (Head of Electrical Engineering Dept.) and Mr. N. L. White (Senior Lecturer) of Brighton Technical College

EMIDEC Computer for Sainsbury

J. SAINSBURY LTD., the grocery and provision company, is the latest commercial organisation to place an order with E.M.I. Electronics Ltd., for an EMIDEC 1100 computer. Its principal use will be for stock control and central accounting for supplies to branches.

This is believed to be the first application of a computer to the stock control problems of a chain of provision stores in this country.

By giving a finer control than can be achieved by conventional methods, EMIDEC will enable the existing organisation to offer the same service as before to an ever-increasing number of branches, while continuing to maintain stocks at minimum levels to ensure perfect freshness.

The computer selected to undertake this work must be capable of processing a large amount of data in a very limited time. The EMIDEC 1100 was chosen, after careful consideration, because its large immediate access store, and rapid input and output facilities, made it the most suitable for Sainsbury's needs.

British Lampblown Scientific Glassware Manufacturers' Association

IN his report for the year, at the annual general meeting, the president, Mr. Stanley J. Davies, said that questions of trade, particularly competition from low-priced imports, continued to play a predominant part in the Council's work. The machinery for obtaining protection against dumping prevented quick and effective action, but this was a problem of consequence to the glass industry.

The Association assisted members in dealing with specific problems varying from questions on overseas tariffs to training and conditions of employment, and provided an excellent opportunity for informal contact between manufacturers.

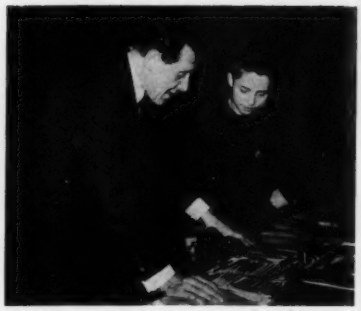
Mr. Stanley J. Davies, chairman and joint managing director of A. Gallenkamp & Co. Limited, was re-elected president.

Mr. P. J. Edward, managing director of Franco-British Glass Co. Ltd., and Mr. H. V. Stout, managing director of H. Stout & Co. Ltd., were re-elected vice-presidents.

Servomex Gift to Brighton Technical College

THE 1,000th servo-operated a.c. voltage stabiliser to be produced by Servomex Controls Ltd., Crowborough, has been presented by the firm to Brighton Technical College. In accepting the gift, Dr. E. G. Watts, principal of the College, said it would be extremely useful to the senior students who would be studying servomechanisms for the University of London Degree and the College's Electrical Engineering Diploma. Many of these students come from various parts of the Commonwealth.

Some modifications were made to the stabiliser to increase its educational value, and it was presented with a wiring diagram and two leather-bound instruction books.



Minister of Education at Metropolitan-Vickers Training School

Minister of Education Visits Metropolitan-Vickers Apprentice Training School

THE RT. HON. GEOFFREY LLOYD, M.P., Minister of Education, visited the Metropolitan - Vickers Apprentice Training School, Trafford Park, prior to attending a press conference at the Royal Technical College, Salford.

He is seen chatting with Michael Steeples, a sixteen-years-old probationary apprentice in the Instrument Making Section of the School.

I.C.T. Expansion in Germany

I.C.T. announces the formation of I.C.T. G.m.b.H., a subsidiary company with headquarters in Düsseldorf. It will take over the existing business in Western Germany of Powers-Samas Accounting Machines (Sales), which has previously been conducted through a branch office in Düsseldorf and merge this with the wider interests and resources of I.C.T.

By the end of this year it is planned to open branch offices in Hamburg, Stuttgart, Hanover, Berlin, Nürnberg and Munich.

Changes of Address

THE London District Office of Siemens Edison Swan Ltd. has moved to Crown House, Aldwych, W.C.2 (Tel. No. TEMple Bar 8040), and from there all sales and deliveries will be controlled for the London area, which will include the Home Counties and the branches at Reading, Maidstone, and Ipswich. The London District Office will continue under the management of Mr. J. A. E. Trinder.

The sales service and supply element will be under the management of Mr. R. J. Seaman, and the stores will remain at Tyssen Street, Dalston, E.8.

The address of Technograph Printed Circuits Ltd. and Technograph Electronic Products Ltd. new offices is:

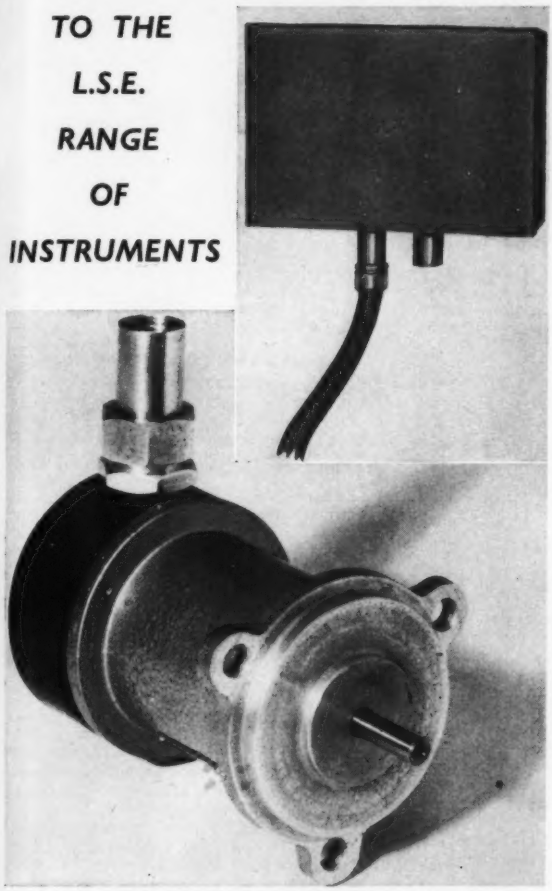
Eros House,
29-31 Regent Street,
London, S.W.1.
Telephone: REGent 5273/5

THE address of the new Manchester branch office of Short and Mason Ltd. is:—

30A London Road,
Manchester, 1.
Tel.; CENTRAL 3044.

Mr. William K. Gregson, the Northern area representative, may be reached at this address.

ANOTHER IMPORTANT ADDITION TO THE L.S.E. RANGE OF INSTRUMENTS



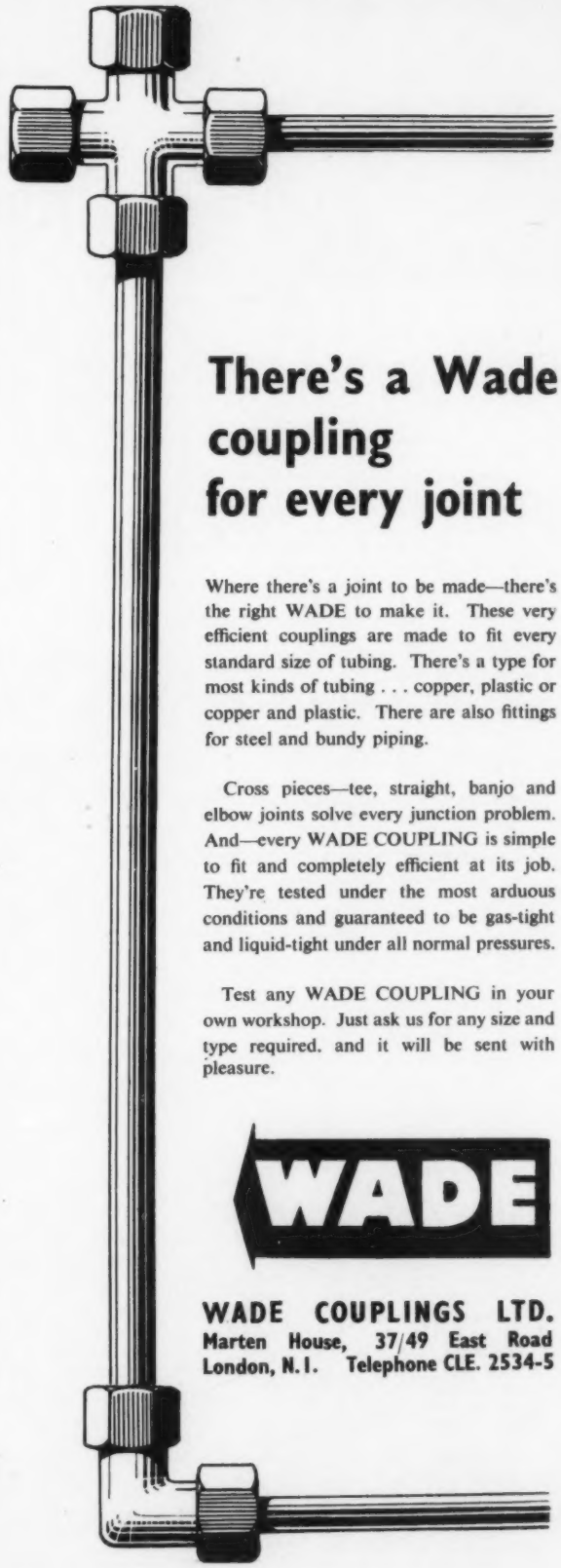
A BRUSHLESS D.C. TACHOGENERATOR

This new addition to the range of L.S.E. Instruments consists of a twelve-phase alternator connected to twenty-four silicon or germanium diodes. This combination has been developed to meet the demand for a d.c. tacho which will operate indefinitely without servicing as required for a continuous process control system.

D.C. Voltage Gradient per 1,000 r.p.m.:
50 V. ±1% into 8,000 ohms.
Linearity:
Better than 1 r.p.m. from 200-3,000 r.p.m.
Peak to Peak Ripple Content:
Less than 4%
Fitting Diameter: . . . . . 2¾"
Length: . . . . . 6 7/16"

Details of the full range of L.S.E. instruments are available from:

LAURENCE, SCOTT & ELECTROMOTORS LTD.
Instrument Department,
OPENSHAW, MANCHESTER



There's a Wade coupling for every joint

Where there's a joint to be made—there's the right WADE to make it. These very efficient couplings are made to fit every standard size of tubing. There's a type for most kinds of tubing . . . copper, plastic or copper and plastic. There are also fittings for steel and bundy piping.

Cross pieces—tee, straight, banjo and elbow joints solve every junction problem. And—every WADE COUPLING is simple to fit and completely efficient at its job. They're tested under the most arduous conditions and guaranteed to be gas-tight and liquid-tight under all normal pressures.

Test any WADE COUPLING in your own workshop. Just ask us for any size and type required. and it will be sent with pleasure.

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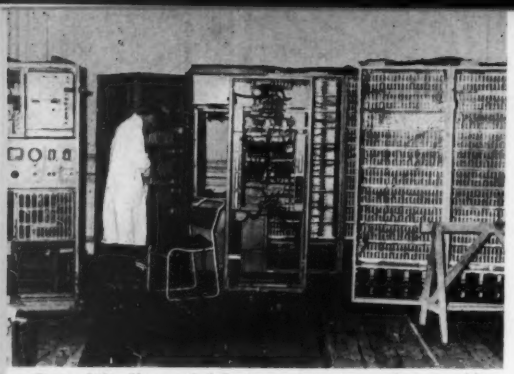
EXPORT NEWS



Part of the dismantled Perseus data processing machine which recently passed final acceptance tests at the Bracknell laboratories of Ferranti Ltd.

Ferranti Perseus en Route to Sweden

COSTING £300,000, Perseus is the largest data-processing machine yet made in Western Europe, and this first machine will be installed at the Trygg and Fylgia Insurance Companies of Stockholm.

The factory tests, conducted in the presence of a Trygg and Fylgia engineer and observer from the National Physical Laboratory, were successfully completed well within the allotted time for a complex machine of this size.

Perseus will start its new life by maintaining hundreds of thousands of policy records. It will also issue premium notices, prepare accounts, work out tables of rates and provide working figures.

This prototype is the first of two Perseus data-processing systems being exported by Ferranti Limited. The second machine, which is being built at the company's West Gorton factory in Manchester, will shortly be shipped to South Africa where it will be installed in the South African Mutual Life Assurance Society Building in Cape Town.

Export Possibilities of Nuclear Energy

AT the International Samples Fair in Milan nine nations demonstrated their atomic advances.

The United Kingdom Atomic Energy Authority had one of the largest exhibits in the section on nuclear energy, covering 3,500 sq. ft. It illustrated two important but widely different aspects of British work—the industrial development of power reactors for electricity production, both in the United Kingdom and overseas, and the extensive range of radioactive isotopes which the Authority supplies to countries all over the world.

The power reactor section made special reference to the construction by British industry of the Italian power station at Latina, and emphasised the technical experience gained by the U.K. in reactor fuel element design and fabrication. Power station models included a "cutaway" of Calder Hall on which visitors were able to carry out, in simulated form, the control operations of a nuclear reactor.

A number of the ways in which radioactive isotopes can be used were also displayed, including the ways in which these materials can be used for measuring devices, germ destruction, medical work, tracer work, radiology and light sources. The methods used to pack isotopes for despatch were shown, together with illustrations of the global extent of Britain's sales.

A multi-language cinema, with separate and simultaneous sound tracks in Italian, French, German, and English, showed films dealing with the British nuclear power programme, the use of radioisotopes in industry, metallurgical research and animated diagrams illustrating the principles of nuclear fission and the way in which a reactor works.

Solartron Radar Simulator System Delivered

THE recently completed Solartron ten-target early warning and height-finding radar simulator equipment has been flown in two consignments to the Swedish Air Force, in Sweden, from Southend-on-Sea Airport in aircraft supplied by the Royal Swedish Air Board.

The equipment, designed and manufactured by Solartron Radar Simulators Ltd., will provide intensive and realistic training facilities for radar operators and controllers without immobilising operative radar systems and flying aircraft. This gives an immense saving in training costs together with the greatest possible flexibility and training times independent of weather and air traffic conditions.

This equipment has a number of control desks at which the "pilots" sit and "fly" their aircraft. In response to the instructions of the force commander, over a "radio-telephone" network, the pilots operate the synthetic controls on the console panels. Special computers continuously follow the effects created by the controls, such as diving, climbing and turning, and accurately track the aircraft in three-dimensional space. Proper allowance is made for the direction and force of the wind as the aircraft change position.

As the simulated lobes of the rotating search aerial and the height - finder explore their synthetic space, they illuminate the moving aircraft in their computed tracks on the face of a plan position indicator or radar screen. The echo-responses paint-up realistically on the screens.

In this way the radar simulator can fill an empty sky with manoeuvring warplanes, providing a continuous programme of full-scale air exercises without a single real aircraft leaving the ground.

The synthetic aircraft may be divided into two forces, enabling realistic interception exercises and evaluations of tactics to be carried out. Noise-jammers are carried by all aircraft and IFF (Identification Friend or Foe) responses may be provided if required.

The equipment is designed to permit extension of facilities and number of targets as necessary.

Solartron have already delivered radar simulator systems to the West German Air Force and the Italian Ministry of Defence (Artillery) and are nearing the completion of a more elaborate equipment for the Federal German Republic, for the Italian Air Force, and Norwegian Government.

Air Trainers Link Argentine Order

AIR TRAINERS LINK has won a contract, worth around £150,000, for the provision of ground training equipment for crews of the Aerolineas Argentinas' Comet 4 fleet. The equipment includes a four-engine Type AT-100 G.P. trainer, and a complete Comet 4 type trainer. Air Trainers Link is to provide, in addition, courses of instruction for maintenance engineers and instructors who will be selected from the Argentine airline's staff.

Kelvin Hughes Autosonics for Czechoslovakia

KELVIN HUGHES autosonic inspection equipment to the value of £10,000 has been ordered for the Chomutov steel works in Czechoslovakia.

The equipment will facilitate the automatic scanning of rolled mild steel bars of up to 7·9 in. diameter and will mark and reject any material containing internal defects in excess of a pre-determined degree.

Kelvin Hughes engineers will supervise the installation and commissioning of the equipment which will be the first of its kind to be used in Czechoslovakia.

Redifon Flight Simulator for Swissair

SWISSAIR has ordered an electronic flight simulator from Redifon, of Crawley, to be used to train crews for its Convair 880 jet liners.

The simulator will be delivered in May, 1960. It will be used to train pilots and flight engineers of both Swissair and SAS (Scandinavian Airlines System).

The Scandinavian company has already ordered from Redifon a Caravelle jet simulator; Swissair crews will also train on it, since SAS will lease four Caravelle jet liners to Swissair from the middle of next year.

The order also included a total of 25,000 metres of vulcanised rubber insulated cable for operation at 600 volts and 2,000 volts.

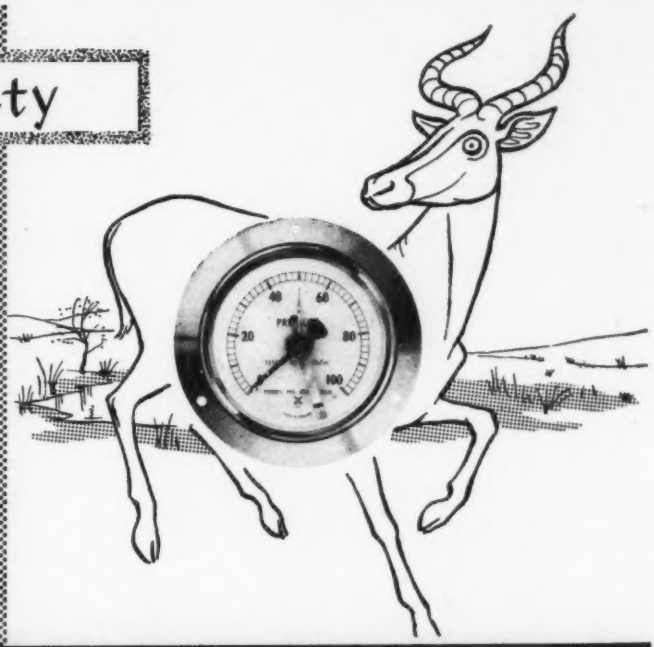
Gresham Transformers for New Zealand

AN order of £20,000 value has been received by the Gresham Transformer Group, Hanworth, Middlesex, from the Ministry of Works of H.M. New Zealand Government for eight 1667 kVA, 33 kV, transformers, single phase. These will work in two banks and will have on-load and off-load tap changing equipment, as required.

Circle 54 for further information

Sentinel of Safety

The Hartebeest is described as the sentinel of the veldt—the most alert of all antelopes.
In industry it is P. & G. electric contact gauges that give warning of action required and they may also be arranged to provide automatic control.
Several types are available with single or double contacts to operate on rising or falling pressures.
Electric contact gauges can safeguard vital equipment, prevent breakdowns and save money. Send us details of your problems and we shall be pleased to offer our advice.



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SMETHWICK - BIRMINGHAM

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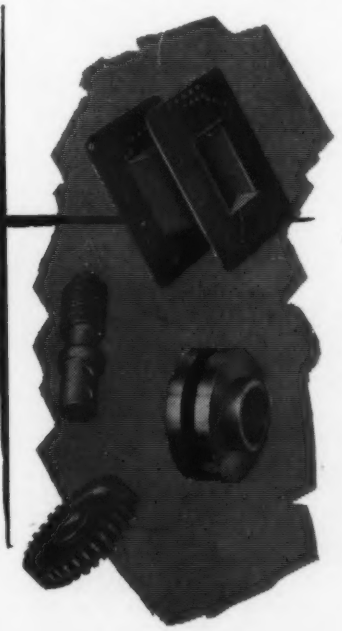

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PERSONALITIES

Air Vice-Marshal A. F. Hutton

Mr. C. G. Marks

Air Vice-Marshal A. F. Hutton

Air Vice-Marshal A. F. Hutton, C.B., C.B.E., D.F.C., B.A. (Cantab.), D.I.C., has recently joined Negretti & Zambra Limited in an advisory and consultative capacity, particularly in those fields of the company's products concerned with aircraft engineering and guided missiles.

Air Vice-Marshal Hutton, who is a Member of the Institute of Mechanical Engineers and a Fellow of the Royal Aeronautical Society, has had a distinguished career with the Royal Air Force. Amongst other duties, he was engaged on research at the Royal Aircraft Establishment, Farnborough, was with the Ministry of Aircraft Production and has held the position of Director and finally Director-General of Engineering, Air Ministry.

Mr. J. Bent

Rosite Limited, manufacturers of electrical insulating materials, and one of the Plessey Group of Companies, announce that Mr. James Bent has joined the Company as sales engineer.

Previously, Mr. Bent was with Permali Limited, of Gloucester, as new products development and applications engineer. Before joining Permali in 1954, he was engaged in the design of metal clad switchgear with Metropolitan Vickers Electrical Company Limited.

English Electric Co. Ltd., Appointments

Mr. G. E. Robertson, A.M.I.E.E., Assoc. Mem. A.I.E.E., has been appointed manager, sales and contracts, of the Meter, Relay and Instrument Division, and Mr. P. G. Bevis has been appointed manager, sales and contracts, Relay Department.

Mr. Robertson joined 'English Electric' in 1950 on the formation of the Relay Department and, before his new appointment, held the position of manager, Meter and Relay Sales and Contracts.

Mr. Bevis joined the 'English Electric' Relay Sales Department in 1951, having served with the Meter Department of the Southern Electricity Board.

Earl of Halsbury

The Earl of Halsbury, F.R.I.C., F.Inst.P., has been appointed to the Board of Lancashire Dynamo Electronic Products Ltd., as chairman.

Lord Halsbury is vice-chairman of Lancashire Dynamo Holdings Ltd. and also has a number of other board appointments with major industrial organisations. He was until recently managing director of the National Research Development Corporation, a position he had held since the Corporation was set up in 1949 to ensure the development and exploitation of inventions resulting from public research.

Dr. Louis Essen

The Royal Society has been informed that Dr. Louis Essen, a senior principal scientific officer at the National Physical Laboratory, has been awarded the A. S. Popov's Gold Medal by the Academy of Sciences of the USSR. This award is for the most distinguished scientific work in the field of radio-engineering performed during the period from 1956 to 1958. The work of scientists from all countries is considered, but this is the first time that it has been awarded to a scientist outside the Soviet Union.

The outstanding achievement which has won Dr. Essen this recognition has been his work leading to the establishment of an atomic frequency standard as a possible basis for the future standard of time which would have greater precision and be more easily accessible than the astronomical standard for the purposes of radio-engineering and physics. Dr. Essen has also played a leading part in establishing that the precision of the caesium standard and the stability of propagation of low frequency radio-waves meet the demands of improved aerial navigation systems which require times and frequencies to be compared over very long distances with great accuracies.

The importance of this work was recently recognised by the presentation to Dr. Essen of the first Wolfe Award, given to the research worker considered by the Department of Scientific and Industrial Research to have made an outstanding contribution to the research work of the Department during 1958.

Mr. C. G. Marks

British Central Electrical Co. Ltd. announces that Mr. C. G. Marks, general manager of the company, has also been appointed sales manager, and assumed responsibility for the whole of the company's sales activity.

Mr. Marks, who served his apprenticeship in the electrical industry with the British Thomson-Houston Company, Rugby, joined the staff of the British Central Electrical Company in March, 1950, as personal assistant to the managing director. He was appointed general manager in 1955.

Rocol: Southern Area Sales Manager

Mr. John G. Gershon, who, for several years, has combined the offices of sales director and Southern Area sales manager, has relinquished the latter and, at the Rocol Head Office at Swillington, near Leeds, will be concerned with the overall United Kingdom sales policy.

In his place, Mr. E. T. Wilkinson has been appointed Southern Area sales manager for the whole of the South of England, including Birmingham, and South Wales. He has been many years with Rocol and was formerly technical representative for South-East England, Hants and Dorset.

Mr. W. K. Gregson

Mr. William K. Gregson has joined Short & Mason Limited as their Northern Area representative and will operate from:

32 Park Road,
Sale, Cheshire.

Mr. T. Kershaw

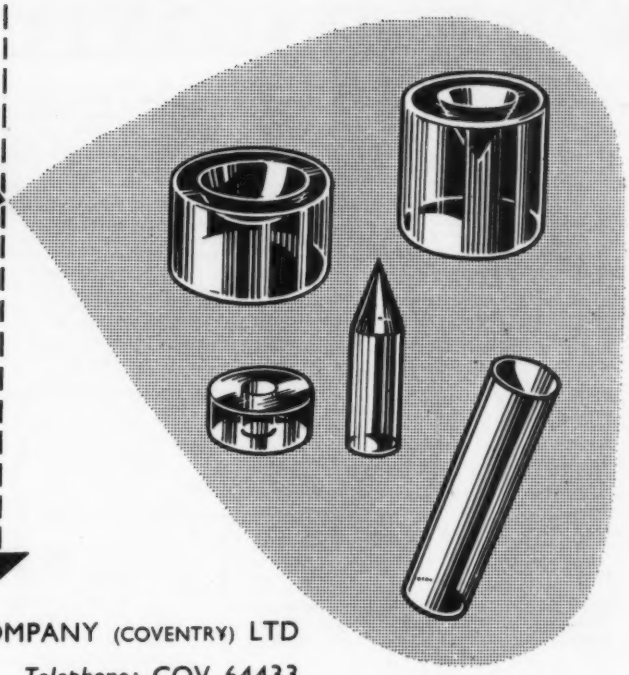
As a further step towards sales representation throughout the country, Amar Tool and Gauge Company Limited have appointed Mr. T. Kershaw as their representative for Yorkshire, Lancashire and Cheshire. Prior to joining Amar, Mr. Kershaw was area sales representative for the Birmingham Tool & Gauge Company Limited before which he was engaged in a similar capacity, for nine years, with Buck & Hickman Limited.

Manager for G.E.C. Publicity Organisation

After 40 years' service with The General Electric Co. Ltd., Mr. M. R. Neville, manager of the Publicity Organisation, retired at his own request on 30th June, 1959. Mr. A. C. V. Clarkson took over as manager as from 1st July, 1959.

Circle 56 for further information

All types of Synthetic Sapphire Instrument Bearings



Also suppliers of diamond saws and waxes for the crystal cutting industry.
Specialists in the cutting to length of small glass tubing up to ¼" diameter.

FRED LEE & COMPANY (COVENTRY) LTD
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THERE OUGHT TO BE ANOTHER NAME

So many people think that a microscope is only at home in the shelter of the Laboratory.

BUT THESE ARE MICROSCOPES — and very fine ones, new precision tools designed for industry. Made for the machine shop, the assembly bench and the inspection room, bringing graphic, three-dimensional vision to bear on every problem of precision. Widely adaptable to suit every need, strongly constructed for a long life of continuous service.

Our List 6E gives all the details. May we send a copy?

W. Watson & Sons Ltd., Barnet, Herts.

Circle 57 for further information

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All advertisements must be PREPAID. Situations Wanted, 4d. per word. Minimum 6s. All other advertisements, 6d. per word, minimum of 10s. Semi-display advertisements, 4s. per line. Minimum £2. Display advertisements at tariff rates. Box Numbers count as four words. Replies forwarded 1s. extra. Replies to Box Numbers must be addressed to *Instrument Practice*, 9 Gough Square, Fleet Street, London, E.C.4.

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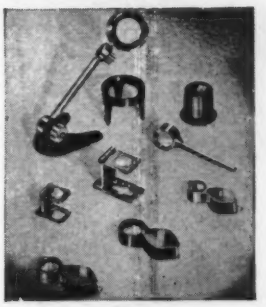

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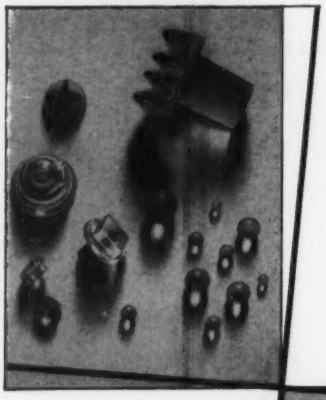

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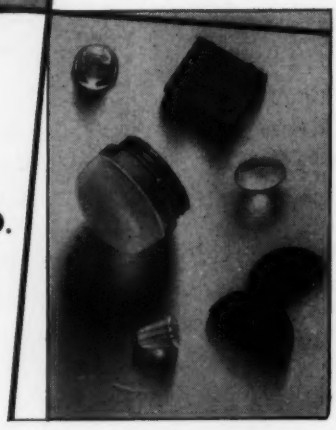

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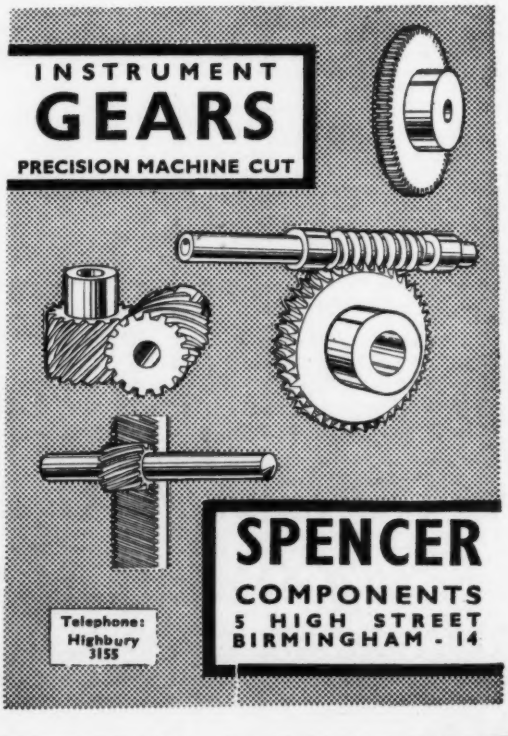

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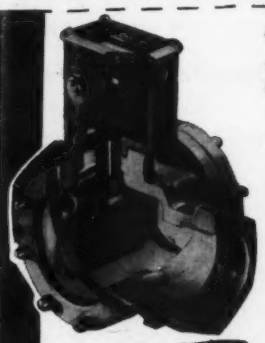

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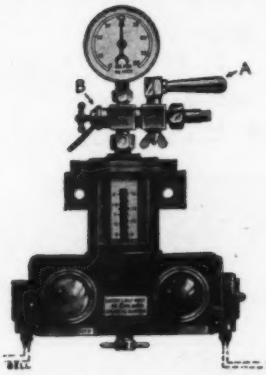

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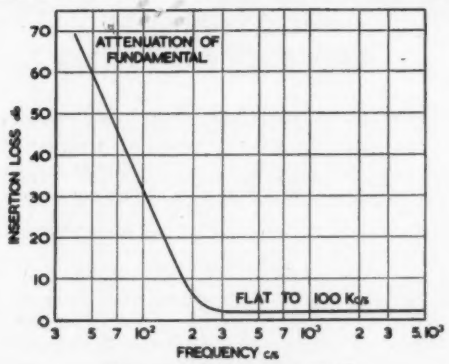

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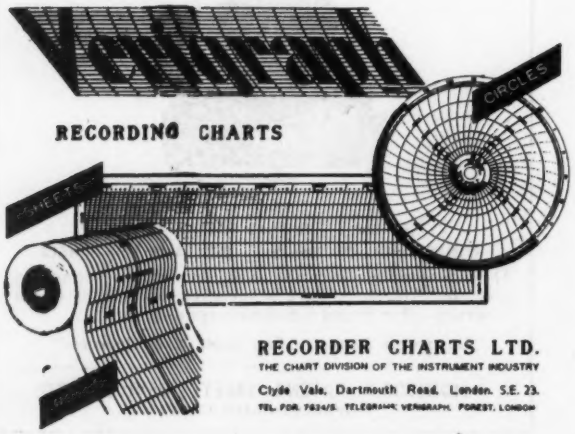

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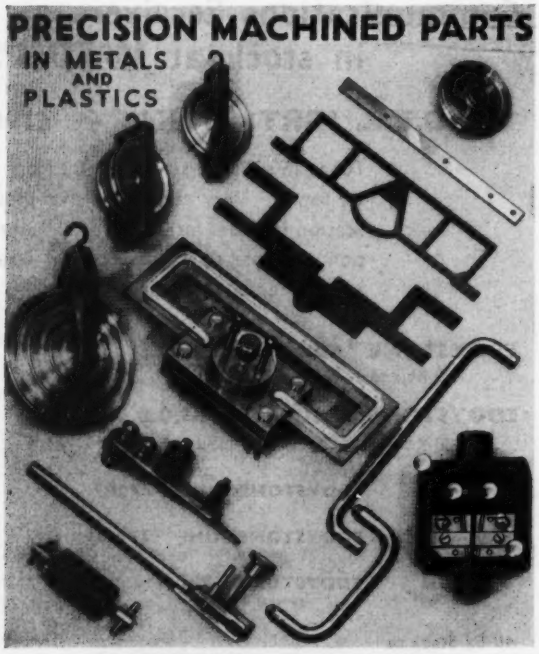

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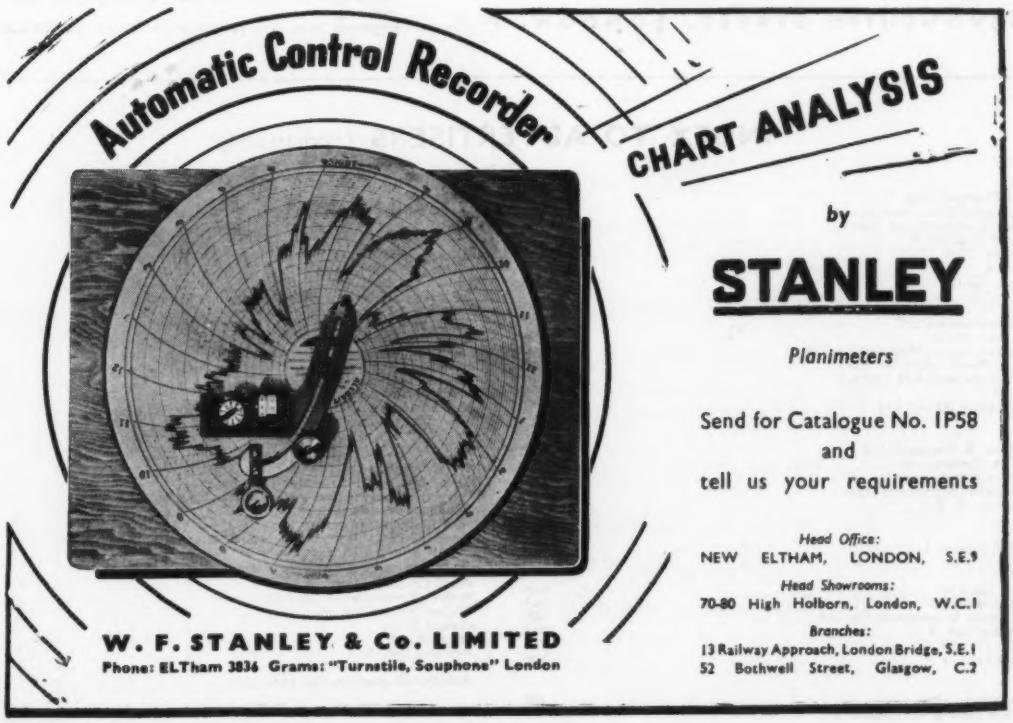

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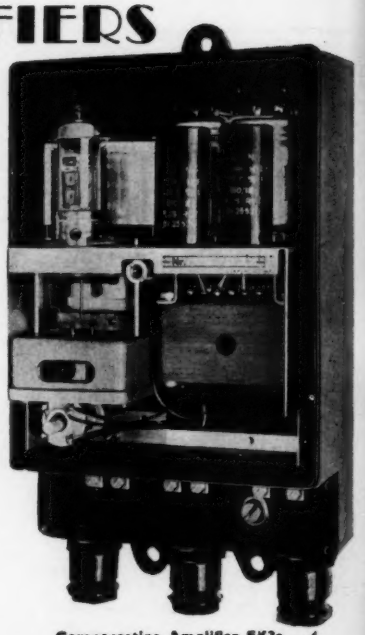

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Published by the Proprietors, United Trade Press Ltd., 9 Gough Square, Fleet Street, London, E.C.4, and printed by Herald Printing Works, York and London.
Annual subscription rate 50/-, to be sent direct to United Trade Press Ltd., 9 Gough Square, Fleet Street, London, E.C.4, England.

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